THE PRACTICAL PHOTOGRAPHER

(LIBRARY SERIES)

EDITED BY REV. F. C. LAMBERT. M.A.

NUMBER 30.

The Pictorial Work of
Ward Muir.

Photographic Chemistry for Beginners.

Numerous Simple Experiments.
Technical Terms
Explained.
The Chemistry of the
Dry Plate Simply Explained.
Etc.

Profusely
Illustrated.

PRICE 1/- NET.

HODDER AND STOUGHTON
27, PATERNOSTER ROW, E.C.

March, 1906.

The Practical Photographer.

Library Series. **Chemistry.** **No. 30.**

Principal Contents.

Illustrations.

Important Announcement.

Increase of Size of Page.

For some time past we have felt that the small size of this present (Library) series of *The Practical Photographer* has not permitted us to present our illustrations to the best advantage. Therefore, with the April number we shall enlarge the size of the page to just about double its present dimensions.

Change of Literary Contents.

This development will enable us to devote much more attention and page space to the pictorial side of our art-craft, without in any way relaxing our attention to the technical side of Photography. It will be our constant endeavour to make the articles on matters pictorial as practical, helpful, and instructive as possible.

Change of Title.

To mark this advance with the times we shall give the new (quarto) form of the magazine the name of

THE PRACTICAL AND PICTORIAL PHOTOGRAPHER.

The present (Library) series, which has now reached its 30th number, has met with such world-wide support and unqualified approval that we cherish the hope of adding several more volumes on the same lines as heretofore. But at the moment of writing we are unable to make any definite statement as to when the volume 31 will be published. (Announcements will appear in due course).

Print Criticisms.

Our print criticism notes and letters have, during the last two and a half years, brought us an enormous number of exceedingly kind letters from all parts of the globe from those who have found our hints of some service. We gladly take this opportunity of thanking one and all these writers for all the kind and generous things they have said, and beg them to believe that their letters have determined us to give still further attention to the criticism of prints in the new series. It is the Editor's intention to continue his personal attention to this department, and we are arranging to criticise the prints with the least possible delay.

The Illustrations.

It is our intention to make a very special feature of the illustrations, and we are endeavouring to arrange a scheme whereby the reader may have a monthly lesson in picture making, and have before him a constantly changing gallery of the best and most representative works of modern photography by our foremost workers.

Mounted Supplements.

This feature will receive our very careful and constant attention, with the aim of forming a unique folio of really valuable examples.

Last but not Least.

The price of the new (quarto) series will remain as heretofore, *viz.*, 1/- net.

The Hand-Camera Companion.

This important, comprehensive and up-to-date book will be published during the latter half of March. In it will be included about 15 half-tone reproductions of some of the winning prints in our recent Hand-Camera Competition. It also contains double our usual number of pages of concisely-worded practical information on the Hand Camera itself, and how to use it for picture-making in all branches. The underlying idea of the whole book is not to lay down any hard and fast rules as to the choice or use of a Hand Camera, but to put before the reader the *pros* and *cons* of each matter so that he can select and act according to his own particular needs. The volume will cost 1/- net bound in paper and 1/6 net bound in cloth.

Here are a few of the topics dealt with, which will perhaps give the reader some rough idea as to its comprehensive scope :—

Hand v Stand Camera.
Cameras.
Lenses.
Definition.
Covering Power.
Rapidity.
Stops.
Depth of Focus.
Focussing.
Focussing Scales.
Finders.
Levels.
Plates v Films.
Plate Speeds.
Backed Plates.
Orthochromatic Plates.
Plate Changing Gear.
Exposure Factors.
Holding the Camera.
Pressing the Button.
The Critical Moment.
Touring Tips.
Easing Moving Parts.
Judging Distances.
Failures.
Limitations.
Dark-Room.
Development.
Fixing.
Drying.
Washing.
Moving Objects.
Clouds.
Panorama.
Landscape.
Portraiture.
Groups.
Figure Studies.
Flowers.
Copying.
Enlarging.
Etc.

Hand-Camera Competition.

We much regret that we are not able to publish the award list in this issue owing to the large number of entries and the time taken up in arranging and classifying the prints into their various sections.

A full list of awards will be published in the Hand-Camera Companion, and a selection of the winning prints reproduced in that volume. The award list will also be given in our April number, enlarged edition. The other winning prints we hope to be able to reproduce ere long in the new *Practical and Pictorial Photographer.*

Criticism of Prints.

It is our desire to make the criticism of prints a special feature in our pages. The Editor gives his personal careful attention to this matter, and aims at making every criticism a practical, interesting, and instructive object-lesson. By paying attention to the hints thus given, often a poor print may be improved and a good print followed by one still better. In order to encourage readers to take great care in the preparation of the prints they send us, we offer **Fifteen Shillings in Prizes** for the best three, four, five, or six prints sent in each month. The winning prints will not be returned. (See Coupon).

This Coupon Expires March 31st, 1906.

THE PRACTICAL PHOTOGRAPHER. COUPON No. 70.

Prints for Criticism (or Queries).

RULES.

1. Write legibly, on one side of the paper only.
2. Put your name, address, and a number on the back of each print, and enclose this coupon.
3. Do not send more than three prints with one coupon.
4. State the *Month*, *Hour*, *Light*, *Plate Speed*, *Stop*, *Exposure*, *Developer*, *Printing and Toning* process employed.
5. If prints are to be returned, a stamped and addressed label or envelope *must* be sent **with the prints.**
6. The Editor reserves the right of reproducing any print sent in for criticism.
7. Prints should be addressed:—THE EDITOR OF *The Practical Photographer* (Print Criticism), 27, PATERNOSTER ROW, LONDON, E.C.

Print Criticism Competition. Awards:

The prints sent in during January were rather over the average number and considerably above the average quality. We note that some of our regular senders are allowing the youngsters to overtake them. This calls for serious thought.

Awards: J. W. Parker, "Sail in Sight"; F. E. Tinker, "Portrait Study"; J. Perrin, "Landscape"; Wm. Keightley, "Fruit Study"; B. Schön, "A Wet Day, Cambridge"; H. Light, "Chrysanthemums."

Highly Commended: J. C. Stevenson, C. Peacock, R. Low, E. Goring, C. D. Baxendall, F. A. Tinker.

Night and Artificial Light Competition. Awards:

The response to this competition fully came up to our expectations in point of numbers, and far exceeded them in general excellence of work and great variety of effects. There was not a poor print sent in. The majority were well above the average, and the number of certificates will show how keen the competition was at the last lap of the race. We are delighted to find that a lady heads the list, and we offer her our hearty congratulations.

Silver Plaque: Miss M. E. Wright, "Diligence."

Bronze Plaque: A. Gordon Smith, "The lamp that caused the trouble."

Certificates: H. A. Costello, "Lily"; J. A. Jarvis, "A Son of Vulcan"; A. Webb, "A Winter's Night"; S. G. Kimber, Norman Crypt, Winchester, D. W. Elliott, "Home Lessons"; A. W. Cooper, "A Modern Amateur Photographer"; R. Williamson, "S. Louis Exhibition by Night."

Highly Commended: J. C. Stevenson, T. K. Hackett, E. T. Robson, J. Turner, R. Cavendish, Nurse Davis, G. D. Swan.

General Notices.

1. It is particularly requested that any errors in the spelling of **Award Winners' names** should be notified to the Editor immediately they are observed.

2. Will contributors to our various competitions kindly refrain from sending *under one cover* prints for *different* competitions? This not only gives us considerable trouble, but involves the risk of the various pictures not being properly entered for the competition for which they are intended. It is far better for all concerned to send each lot of prints in separate parcels.

3. Will competitors please notice that the latest date for receiving prints for our competitions is that given on the coupon, and that we *cannot admit late arrivals?*

Fig. 1 (p. 4).

Ward Muir.

IN ROQUEBRUNE.

THE PRACTICAL PHOTOGRAPHER.

Library Series. **No. 30.**

The Pictorial Work of Ward Muir.

MR. WARD MUIR'S photographic pictures which are reproduced in this volume have many features of interest well worth careful looking at and also thinking about. Like many other works of an impressionistic character their purport may not at once strike the observer. But this feature of pictorial work of this order is by no means its least valuable side.

Mr. Muir took up photography in a more or less conventional way some fifteen years ago, and was fortunate in having as friend one who was able to pilot him through the shoals and quicksands of matters technical, so that he got a thoroughly good grounding on the craft side, and was thus well equipped when the pictorial side gradually began to claim his serious attention a few years later. From this time onwards he has been an important member in the numerically small band of impressionists. But the numerical minority very often represents the force that is characterising the tendency of the age. Beyond a few lessons from an Austrian artist he had not had much art teaching. An extensive knowledge of the contents of the best-known picture galleries of Italy, Paris. Amsterdam, Antwerp, The Hague, etc., has given

him a broad outlook in the great world of pictures, and this, doubtless unconsciously, has largely moulded his taste and aims.

One point of special interest as regards his parentage may be noticed. His father was what is called a "born naturalist" and an expert microscopist. He possessed some skill in drawing, which he used for scientific drawings chiefly of a botanical character. To these qualifications must be added a keen interest in impressionism backed up by a sound judgment of art generally.

Many people appear to think that science and art are opposed to each other, but a closer look at the work of all scientific discoverers shows us that imagination is the background upon which they embroider their theories and marshal their observations. It is imagination which suggests the questions put to nature in form of experiment, and imagination is the invisible thread which enables them to bind up in orderly bundles the answers which nature gives. On other pages of this number we read of atoms, molecules, forces, etc., which for all we know only exist in our imagination; yet without these imaginations the scientist would find himself in chaos confounded.

We have not space just now to discuss the connection between imagination, the parent, and impressionism, its offspring, but their close connection barely needs mention to be recognised.

Mr. Muir prefers a stand camera—as probably does every serious photographer—but preferences are not always possibilities, and as a matter of fact he has done the greater part of his work with the hand camera, so that he is another example, if such be needed, that the hand camera, in capable hands and guided by judgment, can give us pictures as well as promiscuous snap-shots of the usual order. Mr. Muir is what we may call a born traveller, and seems equally happy almost anywhere. Though comparatively quite a young man, yet he has had a width of travel and variety of experience that would surprise many a man twice his age, who had spent double the sum in "going about." It will therefore not surprise us to find that a large proportion of his negatives have been exposed

abroad, although the selection we have been permitted to use do not happen to be especially characterised in this way. However, it does not so much interest the pictorialist to know where the negatives were taken as to know the general aim which prompted their being taken. This our artist can tell us in a sentence, *viz.*, "In most cases my aim has been to render some hackneyed subject in an unhackneyed way, or to find unhackneyed subjects in hackneyed places."

We would ask the more serious of our readers to give these words their very earnest attention, because in them we have the kernel of the nut so many are trying to crack, *i.e.*, "How to make a picture." The answer is not by following rules of composition, or ignoring them either; not by imitating someone else's style, manner, or mannerisms; not by ignoring technical excellence or thinking of that only, but by finding a subject which appeals to *you*, and dealing with it in *your own way*. Some one else *may* have selected the very same subject. That does not matter provided you do not repeat his manner as well as his subject.

The thoughtless ease with which a negative—of a sort—can now-a-day be made, tends to encourage —or at anyrate permit, so much unthinking *work* to be done—or should we not say plates to be *played* with—that future pictorial photographers will have good reason to be thankful for such examples as Mr. Ward Muir sets before us, *i.e.*, work which is characterised by the producer and not just like the same thing done by thousands of other plate users.

Mr. Muir has another piece of valuable advice to give photographers, *viz.*, to study good reproductions of pictures. Indeed he finds that as a rule it is more profitable to see a reproduction of a painting than the painting itself. We hardly feel disposed to agree to this *in toto*, or without a good deal of qualification of terms, but we are entirely with him as regards the great help to be derived from the study of *good* black and white pictures, whether they be reproductions of originals in colour or not. On our own account we would take this opportunity of advising our pictorially inclined readers to miss no opportunity of studying good

black and white reproductions of first-class paintings and wherever it is possible, also seeing the original. Should they have the rare good fortune to find reproductions by two different engravers or etchers from the same original their interest will be all the greater. Nor should they think that if one is right, the other must be wrong. For may we not hear two versions of the same event without either being untrue? Will not each narrator dwell chiefly on what struck him chiefly? And will not this be true of the artist-engraver or etcher, whether he have before him a painting, or a bit of nature. But here again we must resist the temptation to wander too far afield. Let us now turn to Mr. Ward's interesting and varied pictures.

Fig. 1. "**In Roquebrune.**"—In some respects this is not so markedly characteristic of the man as are some of our other examples. Nevertheless it is likely to appeal to many of our readers by reason of its twofold charm of subject and lighting, so that it combines the picturesque with the pictorial, and so may help some of our younger readers to note that these two somewhat similar words mean two quite different things.

Fig. 2. "**In a Southern Courtyard**" will at once strike our readers as a "strong" picture. Bold almost to daring, its directness of attack and vigorous success fully justify this effort. It is another example of the fundamental principle that pictorial quality primarily depends, not on picturesqueness of subject, but on its light-and-shade distribution.

Fig. 3.—**Lion Court, Alhambra.**—The author says that this was done for press use and lays no claim to artisticness. Nevertheless we venture the opinion that many of our readers would be well pleased with themselves if they could always rely on producing results so good as this—and especially when the obvious difficulties of the subject are taken into account.

Fig. 4. "**Autumn Mists.**"—Unity or harmony in all the parts of a picture is a quality of first importance in all pictorial work, be it of the realistic,

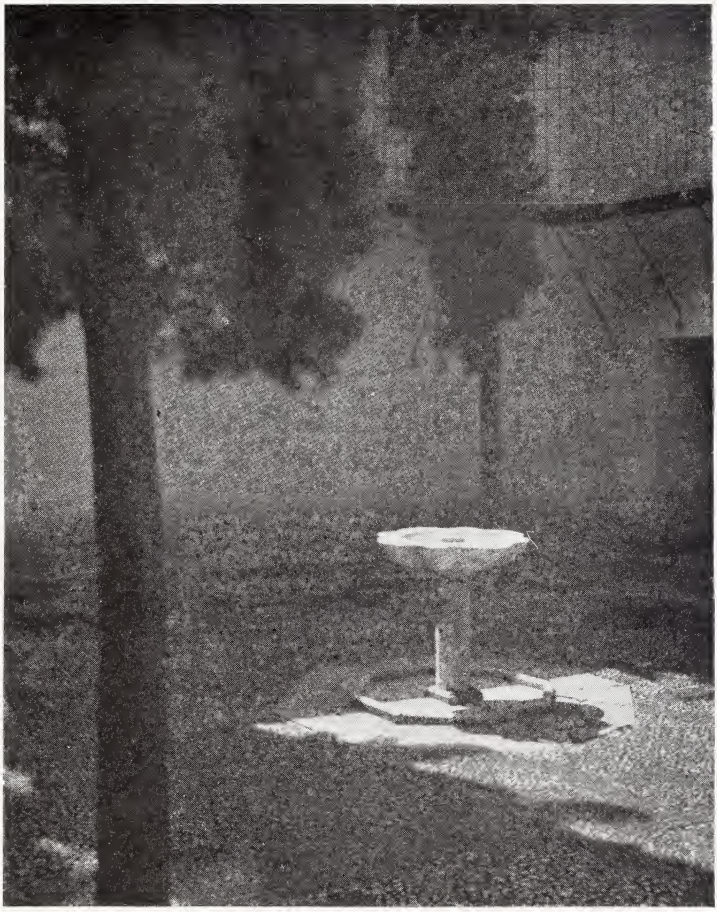
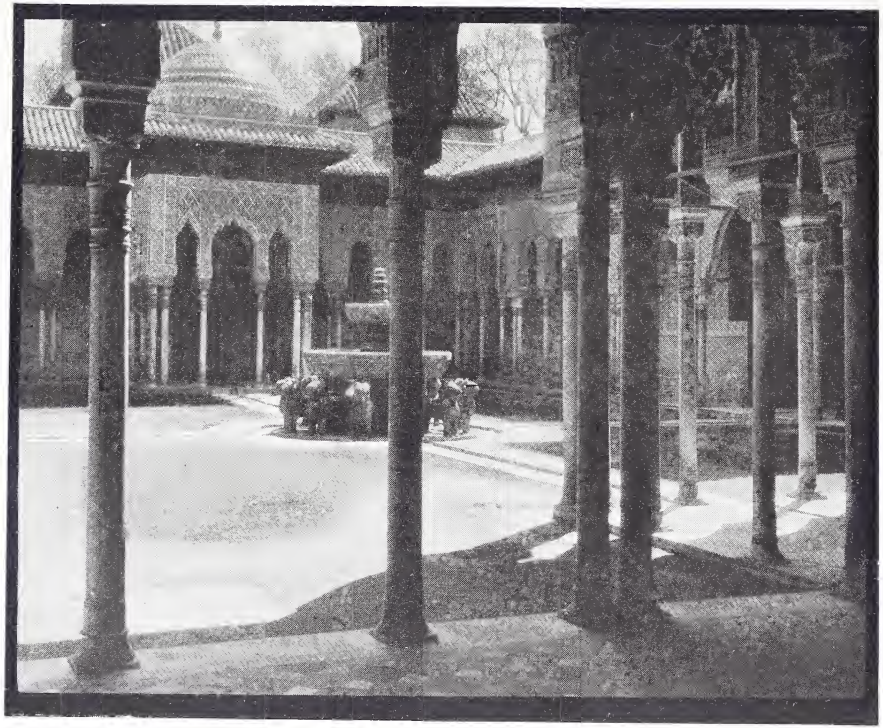


Fig. 2 (p. 4). Ward Muir.

IN A
SOUTHERN
COURTYARD.



THE LION COURT.

ALHAMBRA.

Fig. 3 (p. 4).

Ward Muir.

impressionistic, or any other order. And in the example before us the artist has succeeded in a remarkable degree. The picture and title fit each other admirably, and show us by example—often better than precept—what the impressionist has in his pictorial mind's eye. Impressionism largely depends on its completeness without a jarring note.

Fig. 5. "**The Lake.**"—Most landscape workers will probably agree with us in saying that a lake does not often lend itself to pictorial photography. And while in the picture before us Mr. Muir deals with his subject in an entirely unhackneyed and unconventional way, we are nevertheless not yet wholly convinced that he has completely solved the problem.

Fig. 6. "**The Meadow.**"—Here we have an apt illustration of an everyday subject touched with a personality which at once makes it different from any other "bit" which we have seen. The high horizon, long narrow shape, style of mounting, simplicity of the subject all combine to suggest the open, spaceful, flower-bedecked meadow.

In asking Mr. Ward Muir to accept our hearty thanks for his kindness in lending us his pictures for reproduction we are only expressing half our indebtedness to him. For to the one kindness he added the further help of sending us some notes from which we have extracted or quoted certain hints which cannot fail to make his pictures convey something of the personality of their producer.

An Easy Introduction to Chemistry for Photographers.

HAT happens when we pour the developer on an exposed plate, or put it in the fixing bath? What is "Hypo" or "Bromide" made of? These are fair examples which the beginner is very likely to ask some photographic friend. This little book is designed to put both the beginner and his friend in the way of answering such questions in a non-technical and yet practical manner.

Assumptions.—(1) We shall assume the reader has made no previous study of chemistry. (2) That he is prepared to take a little trouble in repeating a few very simple experiments with such materials as he is likely to have in his dark-room, and apparatus that may be found in the kitchen cupboard or bought for a shilling or two.

Principles *v.* **Facts.**—We think it more likely to help him to help himself, by directing his attention to a few general principles rather than bewildering him by offering a large number of detached facts. And we shall not hesitate to pass over certain refinements, delicate reaction, decimal figures, impurities, etc., so that his mental vision of the chemical picture may not be dimmed by drawing his attention to dust on the window pane.

Personal Experiments.—We lay the utmost importance on his personally conducting as many of the subjoined experiments as possible. Reading about, or seeing experiments done by others, will never give the same mental grip that comes from the personally conducted operation.

Photographers' Materials.—In outlining the following notes we have tried to make use of such substances as are most likely to be found in the ordinary photographer's dark-room (*e.g.* pyro,

Messrs. Baird & Tatlock, 14, Cross Street, Hatton Gardens, E.C., and Messrs. Townson & Mercer, 89, Bishopgate Street Within, E.C., both keep a large assortment of chemical apparatus and materials. But the simple apparatus and materials mentioned in this chapter can usually be obtained from any up-to-date photographic dealer or chemist.

hypo, soda sulphite, etc.). This will save his pocket, and give enhanced interest in these substances which should hereafter prove useful.

Test-Tubes.—Our first need is a few test-tubes of various sizes: a variety of sizes is convenient. When they are not in use some of them fit into each other and are less likely to get broken. They are made of very thin glass, so that the sudden application of heat would not break them as it would were they thicker. With reasonable care and deft handling they will last for years; and apart from these experiments they will often be useful. Make it a rule to clean the inside and outside of each tube after use before putting away. Fig. 27.

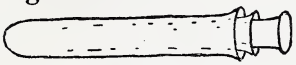


Fig. 27.

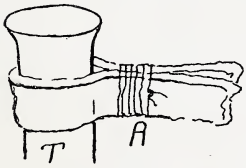


Fig. 28.

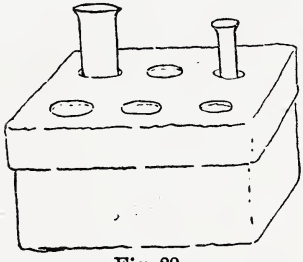


Fig. 29.

A "Spring Clip Test Tube Holder" may be bought for 8d., but we can extemporize one by taking a piece of newspaper 10×8 inches, folding up into a strip 8×1 inch, and then folding this round the mouth of the tube to form a holder when any heating operations are being conducted. Two or three turns of twine or thread at A (fig. 28) hold the two handle parts together.

A Test Tube Stand may be bought for 6d., but again we can "make shift" with an old cardboard collar box. Holes of suitable sizes to fit our several tubes are cut in the lid of the box. A few loose bits of cotton wool or tow are put in the box. Fig. 29 will explain matters.

A Spirit Lamp may be bought for 9d., but here again we can manage very well with a home-

Test Tubes.—The following small selection would be generally useful: one dozen 4×½ inch at 4d. per dozen; half a dozen 5×¾ inch at 7d. per dozen; three 6×1 inch at 1d. each; test tube brush, small size, 2d.

made contrivance. Take a squat-shaped, moderately wide-mouthed bottle (fig. 30), such as an old office gum bottle (B), and fit it with a good sound cork (C). Then from a wooden handled penholder remove the pen and retain the steel tube part which really holds the pen; then get a second similar steel tube holder and fit one inside the other so as to form a fairly stiff and stout short tube. Use this tube as a cork borer, by pushing and turning with plenty of patience until the tube has made its way through the middle of the cork. Remove the cylinder of cork cut by the borer. The tube should now be a good tight fit. At the oil shop buy a halfpenny-worth of "lamp cotton." *Not* a woven wick, but simply a collection of long, straight, rather fluffy, thick cotton strands. Pass this through the steel tube and leave enough to cover the inside of the bottom of the bottle. It should be an easy, neither tight nor loose fit, in the steel tube. Cut the tube end of the wick straight across and let it project about $\frac{1}{4}$-inch above the tube. Half-fill the bottle with methylated spirit and see that *all* parts of the wick are wet with spirit before lighting. To prevent waste by evaporation when the lamp is not in use, we can use a smaller bottle (E) as a cap. This cap should just fit the cork (C). Fig. 30.

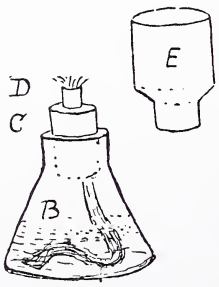


Fig. 30.

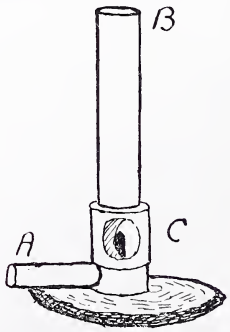


Fig. 31.

A Bunsen Burner.--If the worker can use gas he will find a Bunsen burner* a great convenience. To the tube A, fig. 31, is attached a piece of rubber tubing conducting the gas from the house supply to the "Bunsen." At C is a loosely fitting ring which can be rotated so as to regulate the size of the opening at C and so control the quantity of air

*Price 1/-, 1/3.

Fig. 4 (p. 4)

Ward Muir.

Autumn Mists.

Fig. 5 (p. 5). Ward Muir.

admitted. The flame burns at B. When the valve or opening at C is closed the flame burns with a large luminous area and some smoke. When the air supply at C is increased by opening the valve the flame is not nearly so luminous, but is very much hotter. The beginner is advised to close the valve at C, turn on the gas, and light the flame at B by holding a paper or match close to B. If the hand is held over the tube a nasty burn may result.* The regulator at C then can be opened as required. Should the flame "strike back" and burn at C the gas should be turned off, and a fresh start made. In this case C quickly gets very hot, so caution is required if a burnt finger is to be avoided.

Experiment I.—In the largest test tube place a few pieces of ice; weigh the tube and its contents. Hold the tube in a warm hand until the ice melts. Weigh again. Converting the *solid* ice to *liquid* water has not altered its weight. By refinements of experiment beyond our present powers it can be shown that the space occupied by the ice is a very *little* more than that occupied by the ice cold water. A delicate thermometer will show that the temperature of the solid ice and the water yielded by the melting ice is the same until the last particle of ice has melted. But our warm hand has given out some heat. Where has it gone? Why does not the thermometer rise? The heat passing from the hand has vanished as heat, but is not lost, for it has done work, *i.e.*, changed a solid to a liquid.

Latent Heat.—Hence we may say that it is *latent*, or hidden in the water. Now fix the tube in the paper holder, and hold it at a slight angle (fig. 32) and bring it about six inches away from and over the blue Bunsen flame, or three inches from the spirit-lamp flame, and move the end (B) slowly round an imaginary circle about the size of a penny, so that the centre of the flame

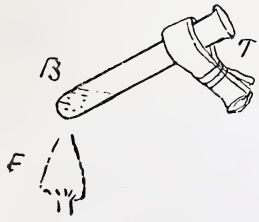


Fig. 32.

* In case of a burn, the best thing to apply is oil or vaseline—or better still, a mixture of equal parts of olive oil and lime water well shaken together.

(F) is not continuously under the same part of B. Tiny bubbles will soon begin to form in the water, and presently the water will boil. Then increase the distance between B and F so as to keep the water gently boiling. Hold the paper handle sideways, so that any water which may be thrown out will not fall on the hand.

Steam.—Notice that between B and T the water-gas or steam is as invisible as air, but when the steam reaches T and comes in contact with the cooler surrounding air it takes a visible form which we commonly, but wrongly, call steam, whereas this visible white cloud is really composed of tiny drops of water formed by condensed steam, *i.e.*, steam converted to water again. Now converting ice to water, or *vice versa*, does *not very much* alter the bulk or volume; but converting water to steam makes a very considerable change of volume. Thus one cubic inch of water would at normal atmospheric pressure occupy 1,700 cubic inches of space as steam. Again, a thermometer held in the boiling water and in the steam would give us the same temperature. Then what has become of all the heat from the flame that has gone through the glass? Again it has become "latent," or hidden in the steam, disappearing as heat, but has done the work of tearing apart the components of the water and spreading them out into a highly elastic mass of steam. Now, if we reverse the process and convert the steam into water by suitable apparatus, we can get back this latent heat.

But the point for us to note is that by applying heat we can change the same substance from solid to liquid and to gas. If none of our material is allowed to escape the weight is the same in all three conditions.

By Reversing the Process we can cool the steam to water and to ice, and repeat this any number of times without changing the chemical or physical properties of the material. As a matter of fact a quite large number of materials that we usually meet in one condition can be converted into the other two conditions. Thus solid iron can be melted, mercury can be frozen solid, the air we breathe can be converted into a liquid, and so on.

Caution.— But here comes our first caution. There are some substances (compounds) which when heated are broken up or resolved into others quite different from the parent substance, and we cannot put together the pieces of the puzzle by cooling. We must therefore be cautious about making sweeping generalisations from our observations.

Decomposition.—For example, if in place of ice we use some white sugar and heat it, it will melt to a brown liquid and presently boil and grow darker in colour, giving off pungent vapours. But on cooling we do not get our white sugar again, but a black mass with little or no resemblance to our parent substance. Hence we may infer that in some cases we can by heat change the state of a substance and reverse operations without altering its properties. In other cases we can change its state, but this alters its properties, so that we cannot reconstruct our substance by reversing the operations.

The Steam Jacket and the Water Bath.—If we test the temperature of the boiling water we shall find that it is constant (100°C. or 212°F.), and that by applying more heat we do not raise the temperature, but only make it boil all the quicker. Again, so long as our test-tube is open to the air the temperature of the steam as it passes along the tube from B to T remains the same as that of the boiling water. If we put a milk basin half-way into the mouth of a saucepan of boiling water, and by a bit of wood or string prevent the two sticking together, we have an efficient water bath; for the steam from the boiling water playing on the outside of the basin will raise it and its contents to the temperature of boiling water, but not beyond this point. This is exactly what we want in many photographic operations.

If, however, our boiling water be in a closed vessel, *e.g.*, iron cylinder, then the steam does not escape, but accumulates and produces what we call pressure, which in turn brings about a rise of temperature. This steam is therefore hotter than boiling water. By such a steam jacket, *i.e.*, steam

confined under pressure, we get very high temperatures.

Water of Composition.—There are numerous substances into whose composition water enters. In some of these the water can be driven off leaving us a substance which is often called the dry (or anhydrous) form of the substance. The "dry" potassium carbonate or "dry" sodium sulphite may be instanced as familiar examples. Again, some substances combine with different relative quantities of water and have corresponding differences of crystalline form.*

Experiment 2.—Take a few small crystals of copper sulphate (sometimes called blue vitriol), and put them in a test tube and heat slowly. Water will be driven off. By holding a cold tumbler (inverted) over the mouth of the test tube we can recognise the presence of this "water crystallisation." Note that heating discharges the blue colour of the powder. Allow the "dry" salt to cool. Add water when we again get a blue solution just like that we should have obtained had we dissolved the original crystal in water instead of heating it. If we evaporate our blue solution we shall get blue vitriol crystals again. There are other substances containing water from which the water can be driven off by heat, which do not re-form on adding water.*

Deliquescence.—Some of the so-called "dry" form attract water from the air when exposed and become damp or wet. Therefore to keep them dry they must be stored in bottles with good sound corks or stoppers, *e.g.*, ammonium, sulphocyanide, calcium chloride, etc.*

Efflorescence.—Other substances which normally contain water slowly part with this water when exposed, and frequently the outer portions of such solids or crystals fall to pieces or become coated with a loosely adherent powder, *e.g.*, kitchen soda, sodium carbonate. Such efflorescent substances should also be kept in bottles. We have said a good deal about water because it enters so largely into our various photographic operations.*

Surface Oxidation.—Other substances on exposure

* *Vide* p. 64.

THE MEADOW

Ward Muir

Fig. 6 (p. 5).

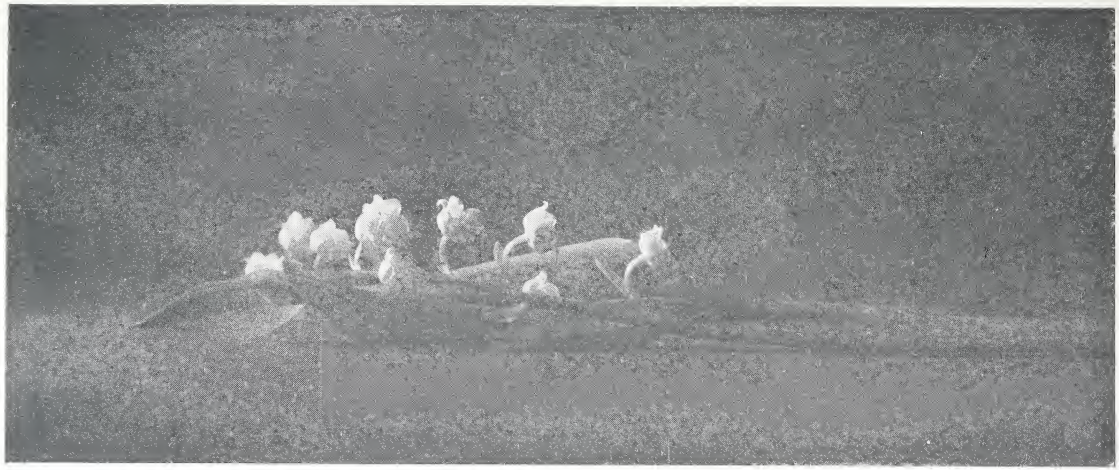


Fig. 7 (p. 60).

Geo. Brown.

LILY OF THE VALLEY.

to the air slowly combine with one of the gases composing the air, *viz.*, oxygen, and form new compounds. The familiar substance sodium sulphite thus forms sodium sulphate. These two substances have quite different properties.

Water in the Air.—Although we cannot always see it, there is always some water in the atmosphere. Its presence, though small in quantity, is of very great importance in practical photography. The reader probably knows that platinotype paper and sensitised carbon tissue have to be stored in air-tight metal tubes along with a substance (calcium chloride) which has a strong attraction for water and so acts as a preserver of the contents of the tube. On the other hand, it is probable that some of our printing papers, albumen-silver paper, gelatine P.O.P., etc., would not print visibly if they were absolutely water-free.

Water as a Solvent is constantly before the attention of the practical photographer. Suppose for a moment we could apply our developer to the exposed plate in the form of a fine powder. This would only reach the surface of the emulsion or coating. But such a powder dissolved in water is able to penetrate all parts of the layer of gelatine. When dealing with paper-supported prints our solvent can enter the gelatine of the coating, and also go in at the back door through the pores of the supporting paper.

Elements and Compounds.—Some centuries ago the division of all things mundane into earth, air, fire and water had to suffice. Later, earth was divided into various kinds, metals, etc.; fire no longer regarded as a material but as an agent, and so on. And so by slow degrees grew the list of primaries or elements out of which all ponderable (weighable) bodies were supposed to be composed. About half-a-century ago the list numbered about 50 elements. At the present it numbers about 80, and theory leads chemists to anticipate this will be further extended in the near future. Of these elements only about a couple of dozen are of immediate interest to the practical photographer. The following may be taken as a representative list:—

Name.	Symbol.	Atomic Weight.
*Aluminium	Al	27
Bromine	Br	80
*Calcium	Ca	40
Carbon	C	12
Chlorine	Cl	35
*Chromium	Cr	52
*Copper	Cu (Cuprum)	63
Fluorine	F	19
*Gold	Au (Aurum)	197
Hydrogen	H	1
Iodine	I	127
*Iron	Fe (Ferrum)	56
*Lead	Pb (Plumbum)	207
*Magnesium	Mg	24
*Mercury	Hg (Hydragyrum)	200
Nitrogen	N	14
Oxygen	O	16
Phosphorus	P	31
*Platinum	Pt	194
*Potassium	K (Kalium)	39
*Silver	Ag (Argentum)	108
*Sodium	Na (Natrium)	23
Sulphur	S	32
*Uranium	U	239
*Zinc	Zn	65

* Metals.

Glancing down this list we see some are marked as metals. The others are usually termed non-metals. In the second column we find the customary abbreviation, *e.g.*, Cr. for Chromium. In several cases these are taken from the alchemists' Latin name given in brackets. In the third column are numbers (approximations only) which are of importance for the reader to understand.

The ancient Greek philosophers conceived all matter or material to be composed of minute particles so small that they could not be divided and hence called *atoms*. After many centuries the idea or conception was revived as an aid to thought. These ultimates or atoms are conceived to be of such infinite smallness that they would be invisible even with the most powerful microscope.

Size of Atoms.—It has been estimated that if an iron or leaden bullet were magnified to the size of the earth the component atoms would be no larger than oranges.

Weight of Atoms.—Now for certain very cogent reasons it is thought that when any two elements are brought to a state of vapour (or as we may say turned into the gas state) there are as many atoms of the one element in a cubic inch of space as there are atoms of the other in the same space.

If we were handed a sealed packet of peas, and another of beans, each packet containing the *same number* of seeds; then by weighing each packet we could learn the *relative weight* of one pea and one bean, without opening the packets.

Therefore, if for instance, we weigh a cubic inch of the vapour of iron and a cubic inch of the vapour of lead, we can ascertain the *relative* weight of one atom of iron as compared with one atom of lead.

These numbers, headed atomic weights, tell us the *relative* weights of equal numbers of atoms and so the relative weight of one atom of each. Hydrogen is taken as the standard or unit as it is the lightest gas or vapour we know.

It will, of coure, be taken for granted that when these difficult and delicate operations of weighing are made, all care is taken to weigh these gases or vapours under the same conditions as to temperation and pressure, or to make proper allowance for any such differences.

Water not an Element.—The beginner may be surprised to find that water is not included in our list of elements, and may be told at once that water is not an element, but a chemical compound of two elements, *viz.*, Oxygen and Hydrogen. Under ordinary conditions of temperature, these are colourless gases, but of late years they have both been liquified and solidified by great pressure and intense cold. In liquid form they generally resemble bluish water.

Mixtures and Compounds.—It is of fundamental importance that the beginner should very carefully distinguish the difference between what are called mechanical mixtures and chemical compounds. This had better be driveu home by the following:—

Experiment 3.—Obtain a small quantity of iron filings or, failing that, some fine iron wire as used by florists, cut it up into tiny bits, weigh this iron and take half its weight of flowers of sulphur, mix them thoroughly. Now stir the mixture with a magnet, and we can thus pick out the pieces of iron; or we can remove the sulphur by throwing the mixture into a liquid called carbon disulphide, which dissolves the sulphur without affecting the iron. Supposing we have used the magnet, we can easily re-mix the iron and sulphur. Put this mixture in a small test-tube and heat slowly. Presently the mixture begins to glow, and the glow is then communicated throughout the mixture. When cool remove the fused mass and powder it. We can see no traces of our iron filings or our sulphur though they are both there without any loss, for the weight of the fused mass will be found equal to the sum total of the separate weights of iron and sulphur. Before heating we had a mechanical mixture, but afterwards we have a chemical compound having properties different from its two constituents.

Gunpowder is a familiar instance of a mechanical mixture of saltpetre, sulphur and charcoal, *i.e.*, carbon. The saltpetre is itself a chemical compound (of potassium, nitrogen and oxygen) which dissolves in water, and so can easily be removed, leaving us the carbon and sulphur. This latter can be removed by dissolving in carbon disulphide.

Now a mechanical mixture is one in which the components may be separated by such mechanical means as solution, sifting, washing (as the gold miner washes away the mud and fine sand while the heavy gold particles sink down) filtering out the sand from a mixture of sand and sugar, which has been thrown into water to dissolve the sugar, and so on. But, more important still, a mechanical mixture may have its constituents mingled in any proportion, whereas a chemical compound demands a fixed and definite proportion. And that is why we took our iron and sulphur in the proportions by weight 2 to 1 (though this is not strictly accurate).

This brings us to the use and meaning of the atomic weight numbers, for they tell us if one atom

of iron which weighs 56 units is to be combined with one atom of sulphur which weighs 32 units we must weigh out our iron and sulphur in these proportions or we shall have an excess of unattached atoms of one or the other elements. The reader must not jump to the conclusion that we can combine one atom of any element with one atom of any other element, because some elements have a double, others a treble, others a quadruple power of combining. For example, we may call the hydrogen atom a single-power combiner, while the oxygen atom has a double power, so that the double-handed oxygen atom can grip two single-handed hydrogen atoms, and in fact, this is their proportion when combined to form water. This is expressed by the chemical shorthand H_2O. The small number 2 tells us that two atoms of hydrogen combined with one atom of oxygen to form a molecule of water. Now each of the H atoms weighs one unit and the O atom weighs 16 units. The total weight of the water molecule is therefore $1+1+16=18$. So that in 18 tons of water we have 2 tons of hydrogen and 16 tons of oxygen.

Experiment 4. — Now to repeat our iron and sulphur experiment in a slightly different form. At the bottom of a dry test tube place a small quantity of yellow sulphur or flowers of sulphur. Make a quite loose-fitting plug of cotton wool for the mouth of the test tube. Then heat the sulphur slowly until it melts and boils, and half-fills the tube with a red brown vapour of sulphur. Take a piece of copper wire, heat one end to redness, and then plunge it into the sulphur vapour (having previously removed the cotton wool plug) and observe that the copper wire glows brightly, and the glow is carried along the wire as far as it is exposed to the action of the sulphur vapour. Withdraw the wire, and when cool note that its end is now black and brittle. It has been converted from copper to copper sulphide by combining with the sulphur vapour. Remember that the combining action set up by heating the end of the wire generated enough heat of combination to carry the action along the wire. This carrying on of an action once started has its parallels in our photo-

graphic practice, though we do not see it in this vivid way. (We may repeat this experiment, using fine iron wire in place of the copper wire.) By weighing a piece of copper, converting the whole of it into copper sulphide and reweighing, we should then know how much sulphur had entered into the combination by noting the increase in weight. In homely language we might say we had burnt the copper in an atmosphere of sulphur, and that, contrary to our usual experience, this burning had increased instead of reduced the weight of the material burnt.

Experiment 5.—Now take a dry and rather long narrow test tube and put into the bottom of it as much red oxide of mercury as would lie on a threepenny piece. Then, holding the tube at about 45 degrees to the vertical, heat the lower end containing the red oxide powder, and note that presently it changes in appearance, going to quite a dark brown colour. Take a large wooden match, cedar-wood spill, or other fragment of wood, light one end in the lamp flame for a second, then blow out the flaming wood and plunge its glowing end into the open mouth of the tube, when the red glow will burst into a flame. Withdraw the wood, blow out the flame, and repeat. The red oxide is giving up its oxygen, and it is this gas which feeds the glowing wood, causing it to burst into flame. Withdraw the tube from the lamp flame and examine the upper part of the tube, which will present a silver-like coating. Take a wood match or roll of paper, hold the tube horizontal and rub the inside of this silver-like surface, noting that you get some tiny globules of mercury or quicksilver, *i.e.*, a silver-like metal which is liquid at ordinary temperatures. By this time the remainder of the oxide powder has come back to its original red colour on cooling.

Thus by heat we can separate the compound mercuric oxide or red oxide of mercury into its two components, *viz.*, metallic mercury and non-metallic oxygen gas. Now the air we breathe is a mixture (not a chemical compound) of oxygen, nitrogen, and a small proportion of a third gas, *viz.*, carbonic anhydride, commonly called carbonic acid

Fig. 8 (p. 61). R. Low.

PROFILE STUDY.

Fig. 9 (p. 61). Zeph Carr.

THROUGH
THE
WOODS.

gas. (The air also contains some other things in relatively small quantities which we may ignore at present.) But in ordinary atmospheric air there is (roughly) about four times as much nitrogen as oxygen and as nitrogen is in this connection an inert or neutral sort of gas it simply dilutes the oxygen or combustion-supporting oxygen. Thus if we take a stick of charcoal and put one end in the fire until it glows red, we can keep this glowing by blowing it with a pair of bellows which bring in contact with it a constant stream of diluted oxygen. But if we plunge this glowing charcoal into a jar of oxygen it will burn with a bright sparkling effect.

Thus by heating mercuric oxide we break it up into mercury and oxygen, and then by introducing glowing carbon we combine this recently liberated oxygen; with the carbon and form a compound called carbon-di-oxide, carbonic-anhydride or carbonic-acid-gas, and written in chemical shorthand CO_2. This tells us that each molecule of this body contains one atom of carbon, weight 12 units, and 2 atoms of oxygen, weighing 16 units, or a total of $12+16+16=44$ units.

Now this formula, CO_2, also tells us the weight of two unit volumes. That is to say that *two* pints (or two cubic inches, or any other measures of volume), weigh 44 times as much as *one* pint (or cubic inch etc.), of hydrogen. So that if we want to know whether carbonic acid gas is heavier or lighter than air, we can ascertain this very easily. For atmospheric air consists of one part of oxygen weighing 16 units and four parts of nitrogen weighing 14 units. So that in five parts of air we should have 16 plus 4 times or 14, a total of 72 units. Dividing this by 5 we get a trifle over 14.

But two volumes of CO_2 weigh 44 units as compared with one volume of air weighing 14, or two volumes weighing a little over 28. So that CO is not far off being twice as heavy as air.

Experiment 5.—That CO_2 is heavier than air we can easily show. Take a tall, deep, wide-mouth bottle or jar, such as are used for the display of

sweets in the confectioners' windows. Then bend up one end of a piece of stout wire into a spiral S, fig. 33, and bend the longer part H of the wire at right angles to the plane of the spiral. The flat spiral part should be large enough to support a night-light. The wick is lighted, and allowed to burn a minute or so to get a steady flame. It is then placed on S and gently lowered into the "*empty*" (*i.e.*, containing air only) jar. The flame will shortly grow smaller, and then quietly go out. Raising the night-light by means of the handle, we re-light the wick and again lower it very slowly, and note that though it will burn at the top or mouth of the jar, we soon reach a point when the flame goes out again, because the CO_2 has collected at the bottom of the jar. Hence, well-sinkers and other wise folk lower a lighted candle into such places before venturing themselves, for they know that air which will not support a lighted flame will not support life. If now we turn our jar upside down for a few seconds, and again lower our lighted flame we shall find that it will burn again just as it did before. Now put the night-light on a saucer and let this float on a basin of water. Light the wick and then bring down over it the jar, mouth downwards, so that the edge of the jar is a little below water level. Again the light will go out and the water will rise, showing that some of the air has been used up.

Fig. 33.

Experiment 6.—Take a piece of quicklime about the size of a walnut, break it up into small pieces, and thoroughly shake this up with a pint of water in a bottle. Then filter off some of this "lime-water" through filter paper. Once again burn the night-light in the jar with its mouth upwards, and when the flame goes out remove the night-light and pour into the jar the filtered lime-water. Close the mouth of the jar with the hand and shake up the lime-water in the jar. It will presently grow milky, owing to a combination formed by the CO_2 gas and the lime dissolved in the water.

Experiment 7.—Then take a fresh lot of filtered lime-water and with a piece of glass tube blow a

slow stream of breath through the lime-water. It will in like manner grow turbid or milky.

Experiment 8.—Invert the glass jar so as to empty out the CO_2 recently formed. Then with a length of glass tube exhale slowly into the jar; that is to say, draw in breath (inspire) through the open mouth, then breathe out slowly (expire) through the glass tube and let the free end of the glass tube reach about half-way down the tube. Breathe as slowly as possible, and after inspiring hold the breath a second or two before beginning to expire. Test for the presence of CO_2 by lowering the lighted night-light. In this way we are led to think that expired breath contains CO_2, or otherwise the change that takes place in the air in our lungs is similar to that taking place when the night-light is burning in the jar. In the one case we have light and heat, in the other the warmth of the blood is kept up. Now CO_2 is a gas poison to man and all animals, but not to plants, for they breathe in CO_2 and appropriate the carbon to form their woody tissues and give us back again the liberated oxygen. Thus animals and plants mutually oblige each other in this respect.

We can now understand why there is more theatre headache in the pit and stalls of a theatre than in the gallery, though the latter is the warmer position, and why a charcoal stove in a closed room produces suffocation, and are better prepared to understand why sensitive plates and papers are best kept in places where gas is not burnt. In the case of a fire and chimney the strong up-draught carries the CO_2 up the chimney; but when there is a nice red-glowing fire and not a strong draught the CO_2 formed at the bottom of the grate is partly broken up and becomes divided into *carbonic oxide*, carbon-mon-oxide, CO and oxygen. This carbonic oxide itself burns with a beautiful delicate blue-violet lambent flame, and is again converted into CO_2.

Our wanderings after the oxygen derived from the red oxide of mercury have led us far afield. But before we say good-bye to this beautiful coloured substance we ought to mention that mer-

cury and oxygen can be caused to re-unite by bringing them to a temperature only a little below that at which they part company.

Experiment 9.—Let us take some red oxide of lead and heat this in a test tube. We again find that it also darkens and also gives off oxygen. But in this case we do not get the metal lead, but a yellow substance (Litharge), which is also a combination of lead and oxygen, though the two are combined in different proportions as compared with the red oxide.

It is no use our continuing to heat this yellow-grey oxide, for heat alone will not make the lead and oxygen part company. But by mixing finely powdered charcoal (*i.e.*, carbon) and heating in a suitable vessel, the carbon is able to drag the oxygen away from the lead, and the lead is left behind as a metal.

Lead and its combinations have not very much interest for photographers beyond the case of some of its salts in an intensification method and in an ill-advised toning procedure. But the point for us to grasp is that this (like several other metals) combines with oxygen in various proportions to form different oxides, and that some of the oxygen atoms seem to be held more firmly or, at any rate, differently from other oxygen atoms.

Experiment 10.—The metal which chiefly interests photographers is silver, and therefore we may advantageously make it the basis of some further experiments. Select a threepenny-piece as little worn as possible. (Or take some other small silver object, *e.g.*, disgarded brooch, etc.) Weigh the object with due care. A threepenny-piece when new weighs practically 20 grains. Put the coin in a large-sized test tube and add about a fluid dram of nitric acid (aqua fortis). If necessary apply heat *very gently*, and avoid inhaling the dark fumes (nitric oxide, NO) which are set free. The heat should only just be enough to cause the acid to dissolve the metal. Possibly a little more acid may have to be added later on, *i.e.*, if all the metal is not dissolved. When this is accomplished we have a greenish liquid. The green-blue colour is due to the presence of copper as

well as silver (for our silver coinage is alloyed with one-twelfth its weight of copper to give it hardness and make it wear better). When cool, we pour the greenish acid solution into a tumbler previously half-filled preferably with distilled or filtered rain water, but tap water will serve if need be. In a tea cup put a teaspoonful of table salt (sodium chloride NaCl) and three parts fill the cup with hot water. Stir well. Allow any undissolved salt to settle, and then add—a few drops at a time—this salt solution to the diluted silver solution and mix well. This produces a curd-like white precipitate which quickly sinks down to the bottom of the tumbler. Go on adding salt solution until the addition ceases to throw down any more white curd. Our sodium chloride has given up its chlorine to the silver, and so formed silver chloride, which falls down as the white curdy precipitate, leaving all the other substances (which we may at present disregard) in a state of solution. We stir up the mixture once again, and then set aside for the silver chloride to collect at the bottom of the vessel. We can now pour away the greater part of the "supernatent" fluid and fill up the tumbler with clean water. Stir well and again let the precipitate settle. We now arrange a filter paper in a glass funnel and on it pour out our white silver chloride. Then remove the filter paper and silver chloride carefully so as not to tear the paper, and lay it on a piece of dry blotting paper and put in front of a fire or on the oven top. When quite dry put the filter paper and dry chloride in one scale pan of the balance. Put a similar filter paper in the other scale pan and then add weights to balance the chloride. We now know the weight of the silver chloride and just by way of example we will assume this to be 24 grains.

Experiment II.—We must now make a very important and suggestive experiment. Obtain a piece of sheet zinc about four or five inches square, fig. 34, ZZ. Clean both sides with a bit of sand or emery paper, or scrape well with an old knife. With a pair of pliers bend up one corner X so that it stands vertically when the remainder is flat on the table, towards the top corner of X make a

small hole through the zinc. On the zinc ZZ, lay the spread-out filter paper F with its little pile of silver chloride C. Then take a piece of thin platinum wire, pass one end through the hole X and give it a turn over to fix that end. Then curve the wire P and bring its other end right into the middle of the little heap of silver chloride.

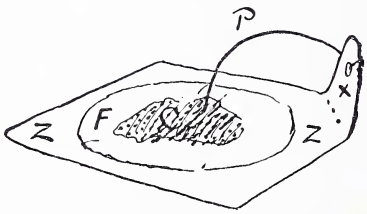


Fig. 34.

Then put the whole arrangement into a soup plate. To a pint of water add about 50 drops of strong sulphuric acid. Stir well and then slowly pour this acid water into the soup plate until the water just nicely covers the heap of silver chloride. Now this zinc plate and platinum wire in the dilute acid, form an electricity-generating apparatus or "battery" and the current of electricity passing along the wire reaches C, the silver chloride and decomposes it into its components, *viz.*, silver and chloride. The latter is absorbed or dissolved by the water, so we do not see it, but we see the white mass gradually turned into a dark grey substance which is really metallic silver in a fine state of division. With the point of a knife take up a tiny bit of the grey mud and put it on a bit of *hard* wood or the bottom of a teacup, and rub with a bit of glass rod, when it will appear as a tiny flake of metallic silver. We must then dry and weigh this gray metallic silver in the same way that we dried and weighed the silver chloride.

Now silver and chlorine atoms are what we may call one-handed atoms, so that a molecule of silver chloride is composed of one atom of silver joined to one atom of chlorine. Turning to our list of atomic weights we find the silver alone weighs 108 units, and the chlorine 35 units, so that the molecule of silver-chloride must weigh 108+35 or 143 units, so that the proportion of silver chloride to silver is 143 to 108. But we started with 24 grains of silver chloride (p. 23) so that our rule of three is as 143 is to 108 so 24 is to required weight of pure silver.

Fig. 10 (p. 61).

DITTON.

J. Johnson.

Fig. 11 (p. 61). A. Turner.

Anxious Moments.

This comes to about 18 grains. We have now obtained pure silver from the alloyed silver of the coin.

Experiment 12.—We next must form silver nitrate by combining silver and nitric acid. Theoretically, 108 parts of silver require 63 parts of nitric acid. But for our purpose we may take equal weights of silver and acid. A very gentle heat may be necessary to start the action and brown gas fumes are given off as before. We may have to add still more acid to get complete solution of the metal. After all the metal is dissolved we now go on slowly heating until the liquid dries up into a rather pasty mass. This is silver nitrate. Then let it go cold, and add about three or four times its bulk of distilled water—warming gently to get complete solution. Then pour out into a perfectly clean saucer, and put in a warm place free from dust. In a few days the liquid will evaporate and leave us crystals of silver nitrate. This substance is the practical foundation stone of nearly all our photographic operations. If a crystal be rubbed on the skin the place soon darkens in the daylight. If a solution be applied to paper, cotton, etc., we get a similar darkening. Hence it forms the basis of marking ink, hair dye, etc.

Experiment 13.—In a teacupful of warm water dissolve a teaspoonful of table salt. Put this in a soup plate and dip into this two or three pieces of drawing paper, then hang them up to dry. Meanwhile dissolve 10 grains of crystal silver nitrate in 2 drams of pure water. Make a small mop by tying a tuft of cotton wool on to the end of a glass rod. With this mop, moistened in the silver nitrate solution, go over one side of the "salted" paper, *i.e.*, previously soaked in salt solution and dried. Dry the second coating in the dark. The silver nitrate and sodium chloride, meeting on the surface of the paper, produce on the paper a coating of silver chloride, comparable to that prepared in the tumbler, page 23.

When the silver chloride paper is quite dry we may lay over it a piece of lace, a small dry skeleton leaf, pattern cut out in brown paper, or an ordinary

photographic negative and expose to daylight. We note that the parts exposed to light gradually darken to purple black, while the protected parts show little or no change. Light has produced a *visible* image. Now tear the print in half. Remove the lace, etc., and expose one half of the torn print to daylight again. The image is lost, because the previously protected parts being now unprotected are darkened. Dissolve one part "Hypo" in ten parts water, and in this immerse the second half of the print for ten minutes. Then wash well and dry. The image remains, but is not so dark as before immersion in the hypo solution. It is also more red or orange in colour. Now expose this print to light without any protection. Little or no visible change takes place. The hypo has removed that part of the paper coating previously protected by the lace, and so kept from darkening. Light, therefore, changes the silver chloride in such a way that the picture can be "fixed" by separating (dissolving) the undarkened part and leaving the darkened part. The question is, what has happened to this silver chloride?

Experiment 14.—In a large test tube put about an ounce of water. Add a dram or so of silver nitrate solution as used for coating the paper. Add a solution of table salt, a little at a time, until no more silver chloride is thrown down. Shake well and let the precipitate settle, pour away the supernatent liquid. Fill up the tube with fresh water. Shake and decant as before. Take three small test tubes. Half fill each with pure water. Now add these three lots of water to the silver chloride. Shake well and quickly divide total contents (chloride and water) equally between the three small test tubes. To each test tube fit a good sound clean cork previously softened by enclosing the cork in clean paper and rolling under the foot on the floor, if no cork presser be at hand. Label the tubes A, B and C. To B add two or three drops of silver nitrate solution, to C add a few drops of solution of common salt. Shake B and C. Lay all three tubes side by side on a white towel or duster in strong daylight. Give each tube a shake at frequent intervals. The silver chloride in B darkens

most and quickest. The presence of uncombined (or "free") silver nitrate in small quantity assists colour change.

C darkens least. The presence of salt solution acts in a manner opposite to silver nitrate.

A is intermediate in darkening. Has the change affected the pure water? Pour off the water from the darkened chloride and divide it into two equal parts in two test tubes. To the first add *one* drop of silver nitrate solution. A milkiness indicates the presence of chlorine in some form combining with the silver nitrate to reform silver chloride.

Into the second tube B, add one drop of salt solution. No change shows us the absence of silver nitrate.

From these experiments it would appear (1) that the light action which darkened the white silver chloride was accompanied by a chemical change which discharged chlorine, which in turn dissolved in or combined with the water; (2) that the extra silver nitrate assisted or favoured this light action, and (3) the salt solution (sodium cloride) hindered or retarded it.

We might therefore say that silver nitrate, in this connection, aided or added to the *light sensitiveness* or was a *sensitiser* in assisting decomposition, possibly by attracting or absorbing the discharged chlorine, and that salt was a retarder. We may at this point assume that the decomposition action in all three tubes is the same in kind, although different in degree.

We may now add the contents of all three tubes together in a large test tube, fill up with water. Shake well and decant once or twice so as to have only pure water and the mixture of darkened and undarkened silver chloride or whatever the products of light on silver chloride have given us. Now, as before, divide the total lot into three equal portions so that the three tubes, D, E, F, contain equal quantities of coloured mixture in the presence of about half a tube full of pure water, and expose to strong sunlight with frequent shaking. For we must remember that this chloride mixture is composed of *small* lumps and the outside of these

lumps darkening prevents the light action penetrating to the inside of the lumps so that a *thin* skin of the darkened product would cover a comparatively large lump of unaltered chloride. Therefore vigorous shaking will help to break up the larger lumps and expose their inside parts to light action. After prolonged action to strong light, pour away the supernatent fluid from the three tubes, D, E, F. Into D put some freshly prepared and *filtered* hypo solution (one part hypo, ten parts water). Note that a large proportion of the solid dissolves, leaving us only a *very small* quantity of very fine black powder. Collect this towards the bottom of the tube by gently tapping it against the finger end. Pour away the hypo solution. Add distilled water. Shake up and again collect the fine black powder at the bottom of the tube. Pour away the water. Then add a few drops of nitric acid and warm slightly. The black powder dissolves just as did the silver powder in experiment 12.

To tube E add nitric acid and warm gently. No change of bulk takes place, nor is the colour removed. Pour away the acid, fill up with water, shake and decant twice or thrice. Pour away the water and add liquid ammonia. The residue dissolves just as does ordinary undarkened silver chloride in hypo. We thus are led to think that light breaks up some of the silver chloride into silver and chlorine, and leaves some unaltered chloride behind.

Take tube F and proceed as in tube D, but instead of using hypo use ammonia.

From the foregoing we very naturally might be tempted to generalise and say strong sunlight darkens silver chloride by breaking it up into silver and chlorine. But refined experiments seem to show that if the chloride be prepared with care so as to avoid the presence of any impurity, and is also *perfectly* dry and is enclosed in a vacuum tube, then sunlight does not cause it to change colour, though we cannot say that it has no action on it. But if similarly enclosed in a tube containing atmospheric air which always contains moisture, or if the tube only contains water vapour without

any air, it will be colour changed by light. Or if the tube contains a small particle of a substance which readily combines with chlorine gas, such, for instance, as a tiny drop of quicksilver, then we get colour change. But if the chloride is enclosed in a tube containing chlorine gas (no air or moisture), then no colour change takes place.

Halogens.—There are known to chemists four elements (so regarded at present) which bear a strong family resemblance to each other. These are chlorine, bromine, iodine and fluorine. The last named (fluorine) exists in nature in abundance in combination with the element calcium as calcium fluoride. Fluorine by itself is a greenish gas attacking glass, therefore it has to be prepared in platinum vessels. It combines with hydrogen, forming hydrofluoric acid or hydrogen fluoride, which also attacks glass. It also combines with silver, forming silver fluoride (AgF), but this salt is of no special photographic interest at present.

Experiment 15.—Take a small piece of sheet-lead, say 5 × 4 inches, and fold upwards ¾ inch all the way round, so as to form a tray in shape like a quarter-plate cardboard box, but somewhat smaller, so that a quarter-plate forms a flat lid overlapping a little all the way round. Obtain a piece of calcium fluoride (fluor spar, Derbyshire spar, Blue John are other names for the same thing), wrap this up loosely in two or three thicknesses of brown paper and crush to powder with a hammer. Scatter this evenly in the leaden tray. Take an old quarter-plate negative, clear the glass thoroughly, melt a little beeswax or paraffin wax on to one side of the glass, and spread it evenly all over this side by holding the glass in a hot oven for a few seconds. Let the wax set, then with a pin or knife point scratch a design or some letters, so exposing the bare glass in parts. Now make a brick hot by putting it on the oven top. Take this out-doors, lay the lead tray on the hot brick, pour on enough sulphuric acid to just cover the powdered fluor spar, put the wax-coated glass wax-side downwards as a lid or tray. Cover and leave for a few hours. Avoid inhaling any fumes from the appa-

ratus, as HF is highly corrosive and affects the lung tissue. After due exposure to the HF. given off by the spar and acid, the glass lid is removed and the lead tray half-filled with cold water. Avoid touching the solution with the fingers, as it will produce obstinate sores. The glass plate is cleaned by using warm and then hot water. The unprotected parts will have been "etched" (literally eaten). In this way is produced "acid-etched" glass used for fine-grain focussing screens. (Ordinary ground glass is produced by sand-blasting.)

We now take an old negative, perferably one with a good strong well-developed image and put it (film up) in a vulcanite, ebonite, celluloid or papier-maché, but *not* glass or porcelain dish and pour over it a solution made as follows:—Water 10 ounces, potassium or sodium fluoride 50 grains, when dissolved and just before the solution is required for use add 10 drops of strong sulphuric acid. This solution may be prepared in a clean jam pot, but should be poured out onto the negative in the ebonite tray as soon as the acid has been added and the solution well stirred.

The tray containing the negative is gently rocked, when shortly the gelatine film will begin to frill and leave the edges of the glass. Now take a feather or soft brush and gently assist the film to come away from its support. When this is accomplished, pour away the contents of the tray, leaving the glass and film behind. Fill up with water and let the film remain in this. Meanwhile take a piece of clean glass, half-plate or whole-plate size, and lay this in another tray and fill up with clean water. Now you may put your fingers in the smaller tray and lift out the quarter-plate glass and detached film,—taking care that the detached film does not slip away off the glass onto the floor—and so transfer the film to the second dish containing the larger glass. With the aid of the feather we can spread out the film flat and at the same time slowly raise the glass from the tray. The dilute acid has acted on the glass and so separated the film. The film has expanded and so we require a larger supporting glass. Here then we have the

Fig. 12 (p. 61). P. W. Farnborough.

Crab-eating Raccoon.

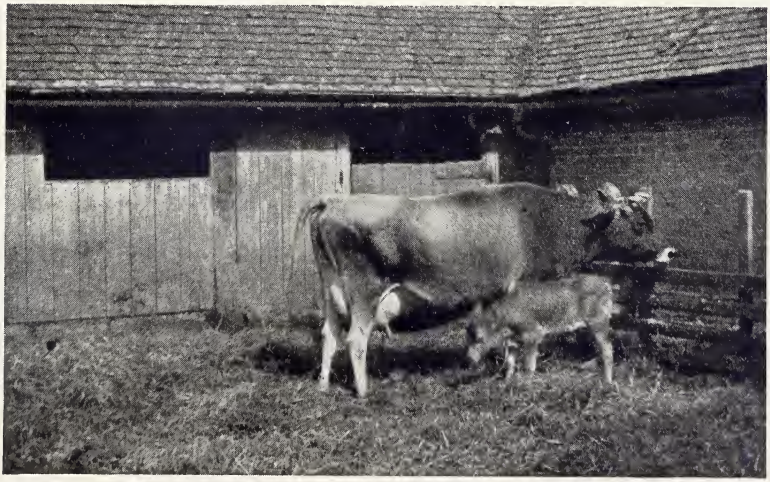


Fig. 13 (p. 62). Miss M. I. C. Mason.

Contented.

Fig. 14 (p. 62).

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Fig. 15 (p. 62).

J. M. Nisbett.

rough outline of film stripping. This is very useful in case of a broken negative when the film is not damaged.

The other three halogens (literally salt producers), chlorine, bromine and iodine, are of special interest to photographers. Silver chloride is the backbone of collodio-chloride and gelatino-chloride emulsions for coating plates and paper. Silver bromide is our mainstay in bromide papers and ordinary dry plates, while silver iodide holds a place of second interest in this connection.

Chlorine is (at ordinary temperatures) a greenish pungent gas, which must not be inhaled. Finely divided silver when thrown into chlorine "takes fire" as the saying is, and combines directly forming silver chloride; antimony, a dark grey or black metal, behaves in a similar way when finely powdered. Copper leaf also acts similarly.

If equal parts of chlorine and hydrogen be mixed in the dark they may be apparently kept indefinitely, but if exposed to diffused subdued daylight they slowly combine, forming hydrochloric acid gas. If a lighted taper be applied to the mixture, or if exposed to direct sunlight, they combine with a *violent* explosion. (Note that a physical agent, *e.g.*, light, causes chemical *combination.*)

Chlorine combines with mercury in two different ways or proportions. In the first we have an equal number of atoms of chlorine and mercury, so we can write down its formula as HgCl. This is known as mercur*ous* chloride, mercury protochloride, monochloride, subchloride or calomel, and is used as a medicine. It is a white powder, insoluble in water, but of no photographic interest.

The other mercury-chlorine compound contains just double as much chlorine for the same amount of mercury as calomel does. We may therefore write its formula as $HgCl_2$. This is known as mercur*ic* chloride, mercury bichloride, perchloride, corrosive sublimate, or white precipitate. This occurs as a white crystalline substance, soluble in water, and used by photographers for intensifying

negatives and prints and for other purposes. By digesting calomel (protochloride) with hydrochloric acid and water corrosive sublimate (perchloride) may be prepared.

A solution of the perchloride in water on exposure to daylight is slowly decomposed into the insoluble protochloride and the solution made acid.

Bromine at ordinary temperatures is a dark red-brown evil-smelling liquid. It readily gives off penetrating fumes. Care must be taken to avoid inhaling this gas form of the element. Commercially it is largely obtained from salt beds left by evaporated arms of the sea or inland seas as at Stassfurt. It is interesting to note that the chief consumption of bromine is in connection with photography, and that the total consumption for all purposes is about 700 tons per annum. Bromine and mercury are the only two liquid elements at ordinary temperatures.

In case the reader does not possess any liquid bromine it may be as well for him to learn what it looks like and smells like.

Experiment 16.—In a test tube put a small quantity of powdered potassium bromide, add a few drops of sulphuric acid and heat gently. We then get white fumes of hydrobromic acid (which remind us of the fumes of hydrochloric acid coming from a bottle of the acid when the stopper is taken out) and also a red-brown vapour or gas, which is bromine. Do not attempt to smell either of these gases but begin again by putting another small lot of powdered potassium bromide in a clean test tube, add about twice as much manganese dioxide, and then water to well cover the mixture. Shake gently just to mix and add a drop or two of sulphuric acid and heat gently. The tube will gradually fill with a red-brown gas, *viz.*, Bromine. If the tube is waved about in the air the reader will perceive the peculiar smell of this substance. Bromine gas combines directly with silver, giving a pale yellow body, *i.e.*, silver bromide. (In the Daguerreotype process (1829) a copper plate coated with silver was "sensitised" by exposing to bromine

gas and then "exposed" in a camera, and then "developed" by the vapour of mercury.)

Experiment 17.—To a solution of potassium bromide add a solution of silver nitrate. A precipitate of pale yellow silver bromide results. On exposure to strong day light this changes to a light violet gray colour. Take a piece of "bromide paper," *i.e.*, gelatine and silver bromine. Enclose this between two pieces of clean dry clear glass in a printing frame, and expose for some time to daylight. Open the frame and smell the paper, when the bromide odour will be perceived, telling us that light has set free some of the bromide. Silver bromide does not show so much visible (*i.e.*, colour) change as silver chloride. But the reader's experience will have probably taught him that a short exposure to light has produced a change which can be developed, although this short exposure has produced no visible change; we must therefore be careful to avoid estimating light effect by its immediately visible effect. Silver bromide is (practically) insoluble in water, or nitric acid, but is soluble in strong solutions of potassium bromide, sodium chloride, hydrochloric acid, potassium iodide, and, of course, in hypo solution.

Previous experiment with silver chloride will have prepared us to expect that substances having a strong affinity for bromine will aid the decomposing tendency of light and so act as sensitisers. Such substances as silver nitrate, gelatine, paper, albumen, collodion, act in this way, while certain soluble chlorides, iodides and bromides act as retarders or restrainers. Previous experience with such substances as sodium, potassium, ammonium, bromide will be familiar to the reader as restrainers or retarders. Citrates of sodium, potassium, ammonium are also occasionally used in this way.

Iodine.—This element normally exists as nearly black solid flakes. If we put one or two flakes into a test tube, heat gently and watch carefully, we shall observe that they pass directly into the gas state without first melting as is usual with solids when being converted into gaseous condition. (This reminds us of camphor which diffuses or volatises

without melting. Ice and snow also do the same thing slowly when a fairly strong wind is blowing.) Iodine gas is a dark purple colour. On cooling this gas returns directly to the solid form on the sides of the test tube. (Examine with magnifying glass).

Experiment 18.—Repeat the procedure of experiment 16, but in place of potassium bromide use potassium iodide when we shall get the tube filled with violet iodine gas which is deposited as tiny black flakes in the cooler parts of the tube.

Experiment 19.—To a solution of potassium iodide add silver nitrate, when a pale yellow precipitate of silver iodide is thrown down. Like its sister salt silver bromide it darkens to a pale greenish gray on prolonged exposure to light. But it forms a developable image after a brief exposure.

Iodine, like bromine, combines directly with silver. (In the improved stages of the Daguerreotype process the silver surface was exposed both to bromine and iodine forming a joint, bromo-iodide of silver, which was found more light sensitive than the bromide alone, and so reduced the necessary time of exposure.)

Sulphites, Sulphates, and Hyposulphites.—If we burn sulphur in air we get a pungent evil-smelling gas, formed by combining one atom of S with two atoms of O, and so formulated as SO_2, and called, in consequence, sulphur dioxide or sulphurous anhydride, the latter word meaning "without water." This SO_2 gas readily dissolves in water and forms a combination of $SO_2 + H_2O$ or H_2SO_3, *i.e.*, sulphurous acid or hydrogen sulphite. If the gas SO_2 is passed into an aqueous solution of sodium carbonate, we get sodium sulphite $Na_2\ SO_3$ formed.

Now the chief interest that this substance possesses for photographers comes from the fact that it is a greedy consumer of oxygen.

If, therefore, we wish to make a solution of such a substance as pyrogallic acid, which is liable to be attacked (and so spoiled for us) by the oxygen of the air, we first dissolve some sodium sulphite in the water and then add the "pyro." The sulphite acting like a watchdog, seizes the oxygen atoms before they can get at the pyro, and so it is called a *preservative.*

Experiment 20.—In an ounce of water dissolve a dram of sodium sulphite. Of this take a fluid dram (in a test tube) and add a drop or two of silver nitrate solution. A white precipitate of silver sulphite is thrown down.

Experiment 21.—Put the remainder of the solution of the sulphite in a clean developing dish or saucer, and set out in the open air for some hours. Then take a dram of this solution and test with silver nitrate solution. Probably a precipitate is thrown down, but it will be less in quantity than was the case when the sodium solution was freshly prepared.

Experiment 22.—Expose the remainder of the saucer for another day or two and again test in the same way, when by this time the silver nitrate will give little or no precipitate. Exposure to the air has changed the sodium sulphite into sulphate by adding to it some atmospheric oxygen;—thus $Na_2SO_3+O=Na_2SO_4$. Another difference may be noted.

Experiment 23.—If we add a drop or two of hydrochloric acid to the freshly-prepared sulphite solution we shall perceive an odour of burning sulphur, *i.e.*, SO_2, but we do not get this effect when the sulphite has been oxidised to sulphate.

Experiment 24.—Dissolve 50 grains of sodium sulphite in an ounce of water, add 10 grains of flowers of sulphur, and boil gently for a little while. A part of the sulphur will combine with the sulphite, and so appear to have dissolved in the boiling mixture ($Na_2\ SO_3 + S = Na_2S_2O_3$). We now have a solution of our familiar friend "hypo" (*i.e.*, *hyposulphite* of soda, as called by photographers, and *thiosulphate* of soda, as called by modern chemists). Filter the solution when cool, and to it add a little silver chloride or bromide, which, of course, dissolves as we should expect.

Experiment 25.—Take a crystal of hypo, powder it and put it in a test tube. Heat steadily, when presently sulphur is driven off and is condensed in the upper part of the tube if it is cool enough,

Experiment 26.—To a solution of hypo add a few

drops of hydrochloric acid. We again recognise a smell of burning sulphur, *viz.*, SO_2 (sulphur dioxide), and presently the liquid gradually becomes more and more milky.

Experiment 27.—Repeat, but use a large clean tumbler, and have only a dilute solution of hypo. Set the tumbler on a table and place a candle-flame behind the tumbler, and from a little distance note that the colour of the flame changes from yellow to orange and red as the deposited sulphur increases. This experiment helps us to understand how it is that as the setting sun gets nearer the horizon its rays have to pass through a layer of air more and more smoke and dust-laden, and so gets more and more red. It also shows us the result of adding acid to our fixing bath. The widely popular hypo-alum toning bath is a comparable result, the milkiness of this bath being due to precipitated sulphur, which in toning combines with the silver image and gives us a more or less brown intensified or toned image, as we usually term it.

Experiment 28.—To a one-in-twenty solution of hypo add a nitrate of silver solution drop by drop, shaking gently after each addition until the precipitate formed ceases to be re-dissolved. Then note the change of this precipitate from white to brown and black as silver sulphide is formed.

Note that the addition of hydrochloric acid to the sulphite, sulphate and hyposulphite gives us three different results, *viz.*, with the sulphite, SO_2 is evolved; with hyposulphite, SO_2 is evolved and sulphur deposited; with sulphates, no visible action.

Experiment 29.—Take a small quantity, say one fluid dram, of clear unused hypo fixing bath and to it add two or three ounces of water and add some silver nitrate solution. A precipitate is formed which does not dissolve on shaking. Pour away the supernatent fluid and fill up with ordinary fixing bath solution; the precipitate remains undissolved. This shows us that when we have a weak solution of hypo the silver forms a compound (or "double salt" of silver and soda) which is not soluble in either the weak or stronger hypo solution. Now each plate or print put into a

Fig 16 (p. 62). F. A. Tinker.

Swiss Shepherd Boy.

Fig. 17 (p. 62). Geo. Brown.

"What is it, Grandad?"

normal fixing bath uses up or throws out of action some of the dissolved hypo, so practically the bath grows weaker and weaker, or becomes more and more dilute so far as its fixing powers go. Hence the desirability of not being too economical in the matter of using the same quantity of fixing bath for too many plates or prints.

Experiment 30.—In a fixing bath that has been used fairly well and as long as prudence dictates put in a piece of clean bright copper. Or we may use a copper or bronze coin that has been well cleaned with a little whiting and a few drops of ammonia. After five minutes remove the coin, when it will be found coated with metallic silver. This may be still further brightened after it has once dried by rubbing very gently with a cream made of whiting and dilute ammonia.

Experiment 31.—To an ounce of water add 10 drops of strong ammonia, shake, and add drop by drop silver nitrate solution until the precipitate first formed is no longer quite dissolved, but leaves a just perceptible turbidity. We have now a double oxide of silver and ammonia in solution.

Prepare a solution of sodium bi-tartarate (sodium-hydrogen-tartarate) 20 grains, water one ounce. Of this solution add 10 drops to the above silver solution. Hold the test tube in a warm hand for a while, when it will be silvered inside by a deposit of silver like a mirror.

Experiment 32.—Half fill a saucer with clean dry sand. Put into the oven till warm, but not hot. Bed a clean watch glass in the sand and then fill up the watch glass with the silvering solution and leave for a while. On looking at the outside glass we have a convex mirror. A prism may be silvered in this way by suspending it so that the side to be silvered just dips into the silvering solution.

The point of this silvering experiment is that we can have a metal in such a state of delicate balance in solution that it is ready to be thrown down in metallic form by warmth or *some other* suitably selected condition. We may compare the metal to a lot of stones on a steep hill-side, when a touch of one sets it rolling, that starts another and so on till

they are all in the valley. We must not push this analogy too far, but yet it may help us to understand how a solution containing—let us say—gold, platinum, etc., can be so balanced that a very slight disturbance causes the atoms or molecules to fall down upon our print.

But the reader asks why the gold or other toning metal is not deposited all over the print as the silver in our recent experiment is thrown down evenly all over the glass. If now we have a strong hot solution of sugar, and suspend in it a thread the sugar solution as it cools, attaches itself to the solid thread, and hence we find this thread in the midst of the stick of sugar candy.

Experiment 33.—If we take a solution of gold chloride and neutralize any acidity in the solution by adding just enough potassium bicarbonate to bring it to a neutral state, and then insert a clean piece of copper and heat the solution, we shall find the gold is deposited on the copper. In this case the delicately poised gold molecules select the metallic copper to shower their affections on. Similarly it comes about that the metallic silver of our print attracts the noble metal, gold or platinum, as the case may be.

The phrase "gilding refined gold" is often used as hyperbole, denoting the impossible. But in photographic practice depositing silver on silver is a frequent and valuable process.

The problem of development of a negative is a little beyond our depth at this moment, but we may make a very useful half-way house experiment in the following manner.

Experiment 34.—Under an ordinary negative expose a piece of P.O.P. until about half-printed, so that the highest lights are rarely visible, then remove the print and immerse it in a bath of potassium bromide one part, water ten parts. After ten minutes' immersion remove and well wash it in two or three changes of water. Then apply an ordinary negative developer, preferably one containing hydroquinone and metol. The print will continue to grow, *i.e.*, the half-printed image will *develop.* Without dogmatising in any way we can

imagine that an image consisting of granules or particles of silver chloride which have been partly converted into metallic silver, would form good starting points for the deposit of more silver. But as there is no silver in the ordinary dry plate developer this addition of silver to the lightly printed image must be derived from the silver coating of the paper, and when once started by light is continued, controlled, stimulated, assisted, by the developer and the gelatine or other materials adjacent to the silver chloride particles. In fact, we can imagine that the operation may be in some vague way compared with a row of toy bricks set up on end and fairly close together on a flat table, and that the upsetting of a brick at the end in turn upsets the entire row. That is to say that an action once started may under suitable conditions be carried on or propagated.

In the case of a dry plate exposed in the camera there is no visible image. Yet it is easy to imagine that the light has so altered the condition or balance of the atoms composing the molecules, that a very little chemical stimulus initiates and continues their disruption.

Some Common Chemical Words and Phrases simply explained.

By F. C. B.

CHEMISTS say that anything which can be weighed is **ponderable** or **ponderable matter.** Air and other gases can be weighed just like liquids or solids. They divide all kinds of material or matter into two great classes. In the first they put all such things as they cannot split up into two different kinds, and call them **elements.** Thus gold and silver are elements, for neither of them can be split up or separated into anything but gold or silver as the case may be. But water can be split up into two different elements, *viz.*, hydrogen and oxygen. Chalk can be split up into a metal called calcium.

carbon which we are familiar with as charcoal and oxygen, a gas which is one of the gases in the air we breathe.

Hence water and chalk are called **chemical compounds.** Such compounds are **homogeneous.** *i.e.*, the same composition throughout, so that it makes no difference whether we split up a large or a small quantity, the composing elements are also present in the same proportions throughout. But sand is a **mechanical mixture,** and a teaspoonful of sand from one part of the coast would not yield the same elements as that from another part of the coast.

Emulsion.—If oil and water be poured into the same bottle and vigorously shaken, the oil is broken up into tiny globules, and they intermingle with the water, forming a milk-like mixture. Such a mixture would be called an emulsion by chemists. The process of churning milk collects from the milk the many tiny oil-like globules, and forms a more or less solid mass of butter. The word emulsion is used in a slightly different sense by photographers. They take a solution of gelatine in water, and add to it solid particles, such as silver bromide, and by vigorous agitation scatter these solid particles more or less uniformly throughout the gelatine solution, their aim being to separate each particle of the solid silver salt by a layer of gelatine. Or in other words to surround the solid particles by an envelope of gelatine.

If we mix some powdered chalk with some table salt we have a mechanical mixture. We can separate these by **extraction,** that is to say, by throwing the mixture into some fluid which will dissolve one and not the other. In this case we might use water as the **solvent** or dissolving liquid.

A filter paper is arranged in a funnel, and the mixture poured on the filter, when the **filtrate,** *i.e.*, water and dissolved salt pass through the pores of the paper, while the chalk would be collected on the paper. If to the filtrate, in this case, we add a little silver nitrate in solution, we get a white curd-like solid *thrown out of solution,* or **precipitated.** This **precipitate** we can collect by again filtering.

Solids are also divided into crystalline, *viz.*, those which take a definite shape bounded by flat surfaces, and amorphous, *i.e.*, which do not take any constant or definite shape. Examine a few grains of sugar, salt, saltpetre, silver nitrate, potassium bromide, with a hand glass, and note that while the sizes of the particles of any one substance vary, yet their shapes and angles are the same, though the crystalline forms of different substances vary. Compare these with charcoal, gelatine, &c. In some hot water dissolve as much of any one of the above crystalline substances as the water will take up, and set aside in a cool and airy place. In time the water will pass off into the air, *i.e.*, *evaporate*, and the crystals re-form themselves again, showing the same shapes as before.

The **solubility**, or amount of a solid which a liquid will take up, depends on the temperature of the solvent. As a rule, the hotter the solvent the more the solubility. Common table salt, however, is not very much more soluble in hot than in cold water, whereas benzoic acid is freely soluble in hot, but little soluble in cold water. In some hot water dissolve as much table salt and also benzoic acid as the water will take up, and filter the solution while hot. As the solution cools, nearly all the benzoic acid, and very little of the salt, will crystallise out. By collecting these crystals, and repeating with another lot of hot water, all the benzoic acid can be crystallised out before the salt begins to separate. This operation is **fractional** or **differential crystallisation.**

Similarly a mixture of water and alcohol can be separated by heating to a temperature a few degrees below that of boiling water, when the alcohol will boil and pass off, or distil before the water begins to pass into steam. This is called also **fractional distillation.**

Many crystals contain a definite quantity (*i.e.*, proportion) of water, hence called hydrated, which can be wholly or partially driven off by heat. That part which can be separated in this way is called **water of crystallisation**, and the remaining water (if any) is the **water of constitution** which cannot be removed without breaking up the substance. When

all the water is driven off the substance is then spoken of as "dry." Some substances, such as soda sulphate, exist in several forms, *e.g.*, the **anhydrous** or dry salt, the hydrated form which has seven parts of water, and yet another form called Glauber's salt, which has ten parts of water.

Some **hydrated crystals** slowly give up their water of crystallisation and fall to powder. This is called **efflorescence.** Other substances, crystalline and amorphous, attract or absorb water and become damp. Such are called **deliquescent** substances. (Obviously these should be kept in solution if they do not deteriorate when dissolved, otherwise they should be stored in well-stoppered bottles. or if corks be used, the corks should be rendered air-tight by waxing, etc.) If they attract and absorb moisture without changing from solid to liquid they are called **hygroscopic.** But some liquids which attract and absorb water are also called hygroscopic.

A saturated solution is one in which the solvent will not dissolve any more of the substance dissolved. A hot saturated solution will as a rule throw out of solution some of the dissolved substance, as the temperature falls, because the degree of saturation generally falls with the temperature. If a saturated solution of Glauber's salt be made with hot water, and the flask be corked and allowed to cool slowly without moving it will not deposit any solid. But if the cork be then removed from the cold solution, particles of dust in the air will enter the flask and form centres of disturbance, and the solid is then thrown out of solution. The same thing occurs if a small crystal of the salt be thrown into the cold **super-saturated** solution.

Strength of solution is stated either in parts or percentages. We may thus have a 20 grain per ounce solution, or a 5 per cent. solution. The latter means that 100 parts *by weight* of the solution contains 5 parts *by weight* of the substance dissolved, be it liquid or solid.

In this connection it is useful to remember that a fluid (measured) ounce of water weighs 437½ grains. But for all ordinary purposes we may reckon 1 oz., 1 drm., fluid, as 500 grains, or

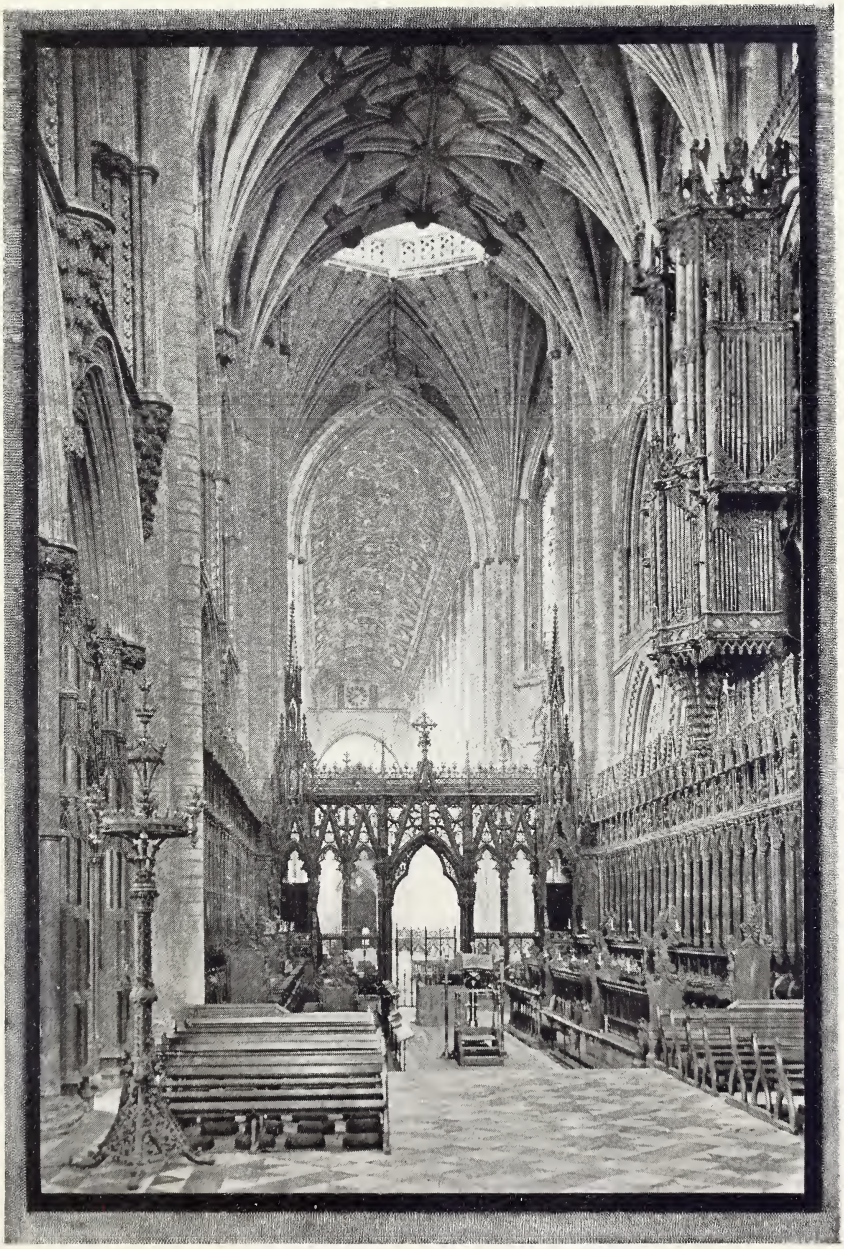

Fig. 18 (p. 62). Stanley Fincham.

The Nave,
Ely Cathedral.

A BIG OF CATTLE COMPANY

Fig. 19 (p. 62). R. W. Lindop.

2 ozs. 2 drms., as 1000 grains. So that a 5 per cent. or 5 in 100 or 50 in 1000 would mean 50 grains of the solid dissolved in, say, 2 ozs. of water, and then water added to bring the total bulk up to 2 ozs. 2 drms.

Many substances, when exposed to the air, will draw from it some oxygen, and combining with it are **oxidised.** Many of our developing agents in solution, such as pyrogallol or "pyro," oxidise, and so deteriorate. If we melt some lead in an iron ladle its surface becomes dimmed and dusted over with an oxide of the metal. This oxide of lead can be made to part with its oxygen by suitable means, *i.e.*, it can be **de-oxidised or reduced.** It will at once be seen that this chemical operation of reduction is not the same thing at all as that meant by the photographic operation of reducing a print or negative. This is more properly *removal by solution.*

Oxidisers are substances which readily part with their oxygen to the body to be oxidised, and they themselves are consequently reduced. It is a case of robbing Peter to pay Paul.

Reducers are substances having a strong affinity for oxygen.

Combustion may be defined as chemical combination accompanied by heat, light or both together.

Distillation essentially consists in converting a liquid or solid into a vapour, and recondensing it in some other vessel. When a substance passes into vapour or evaporates at ordinary temperatures and atmospheric pressure it is called a **volatile** substance, *e.g.*, camphor, ammonia solution.

Sublimation.—When a solid (such for instance as sulphur, iodine) is heated it passes into a vapour which can be reconverted to a solid on cooling. We may therefore regard sublimation as a kind of distillation of solids.

Evaporation.—When a liquid passes into vapour it evaporates. Heating the liquid generally hastens the process. When the liquid contains several different substances these may begin to separate, precipitate or crystallise out at different stages of concentration. The liquid which yet holds bodies in solution is the "mother liquor."

Levigation primarily means grinding to powder, but it is often extended to include powdering two solids which are insoluble in water, and then separating by washing in a gentle stream of water which carries the lighter body away, while the heavier particles fall down as in gold washing.

Lixiviation, primarily applied to dissolving out the soluble part of wood ashes (*lix*, lye), but now used very much in the same way as extraction, (p. 40.)

Fusion is only another name for melting. When smelting or melting metallic ores some substance called a **Flux** is added to assist fusion by attracting or combining with some of the elements of the ore.

Ignition.—In ordinary language we speak of igniting, *i.e.*, applying a light, *i.e.*, burning body, to something else, *e.g.*, gas. When the chemist strongly heats in a hard-glass tube or in a platinum vessel some substance, he calls this process ignition.

Diffusion.—The molecules of two different gases when brought together either combine or they mingle with each other by diffusion. Similarly two liquids diffuse; or a liquid (such as a developer) may penetrate a solid body such as the film of a negative by diffusion.

Element.—A substance which cannot be split up into two or more substances, *e.g.*, silver, iron, lead.

Compound.—A substance which can be split up into two or more substances, *e.g.*, silver chloride, iron sulphide, lead oxide.

Atom.—The smallest quantity of an element which we can conceive to exist.

Molecule.—The smallest quantity of a compound which we can conceive to exist.

Atomic Weight.—The weight of one atom of an element as compared with the weight of one atom of hydrogen.

Molecular Weight.—The weight of one atom of a compound as compared with one molecule (*i.e.*, *two* atoms) of hydrogen.

Specific Heat of a substance is the quantity of heat required to raise a measured volume of the substance through one degree C, as compared with the quantity of heat required to raise an equal volume of water one degree C.

The **Specific Gravity** of a body is its weight as compared with an equal bulk or volume of water.

Isomorphism.—When two different substances take the same crystalline form they are said to be isomorphic. This point of form resemblance is usually accompanied by other chemical and physical similarities. The alums may be quoted as examples.

Isomerism.—When two or more substances have the same percentage composition and the same molecular weight, but have different physical and chemical properties, they are called **isomers**, or **isomerides.** If they have the same percentage compositions, but different molecular weight, they are **polymerides.**

Polymorphism is used to denote that the same substance exists under two or more forms. Thus the element phosphorus may exist as a yellow, waxy, poisonous, solid body, and also as a red non-poisonous powder. It is, therefore, dimorphous. Carbon exists as charcoal, graphite (or black lead), and diamond, so it is trimorphous. The word **Allotrophy,** is used in the same sense as signifying "another form," and in addition to the allotropic forms of carbon, we may mention those of gold, silver and platinum as being of special interest to photographers in connection with the so-called "toning" processes.

Tautomerism is the name given to the phenomenon of a compound, which, while consisting of the same composition and molecular weight, yet shows a difference of reaction due possibly to difference of molecular arrangement. It is probable that there are two different sulphurous acids and that our familiar friend, sodium sulphite, is derived from one, while silver sulphite represents the other.

Analysis is the name of any operation which breaks up a compound into its elements or more simple components.

Synthesis is the exact opposite operation of building up complex bodies from more simple substances. As in the case of oxidation and reduction analysis and synthesis go on side by side.

Acids constitute a class of chemical compounds very difficult to describe without the use of certain

technical terms. They contain one or more atoms of hydrogen which can be replaced by a metal or a base, and so yield a salt. Thus one atom of H and one of Cl form HCl, hydrochloric acid or chlorhydric acid. When the H atom is replaced by Ag (silver) we have AgCl, silver chloride. Other acids contain oxygen as well. These are termed **Oxyacids**. Thus we have HNO_3 or nitric acid, which with silver gives Ag NO_3 silver nitrate, KNO_3, potassium nitrate, and so on.

As the replaceable hydrogen atom (or atoms) in the acid molecule correspond to the metal atoms when salts are formed, it has been thought that hydrogen may be regarded as a metal and that acids are thus salts of hydrogen. We may thus call hydrochloric acid hydrogen chloride; and call nitric acid hydrogen nitrate; and so on. If an acid does not contain oxygen, *e.g.*, HCl, it is sometimes called a **hydracid**. Some acids (*e.g.*, H_2SO_4 sulphuric acid) contain more than one replaceable hydrogen atom in the acid molecule. If all the replaceable H atoms are replaced by a metal or base we get a **normal salt.** Thus K_2SO_4 is normal potassium sulphate, but if only part of the replaceable hydrogen is replaced we get an **acid salt.** Thus $HKSO_4$ is variously called hydrogen potassium sulphate, acid potassium sulphate, or bi-sulphate of potassium. Similarly we have H_2CO_3, carbonic acid; Na_2CO_3, sodium carbonate; $HNaCO_3$, acid, sodium carbonate, hydrogen sodium carbonate or more familiarly bi-carbonate of soda. Many acids have a sour taste (so-called pyrogallic acid is not really an acid in the chemical sense, but belongs to a class of substances collectively called phenols). They turn blue litmus paper red, and turmeric paper brown, solutions of methyl orange to pale yellow, etc. Hence litmus, turmeric, etc., are called **Indicators.**

Alkali is the name given to denote the properties of certain bodies of an opposite character. Thus an alkali turns red litmus blue, phenol-phthaline solutions pink, etc. Alkaline characters were first recognised in the ashes of plants called *Kali*, hence the name. Their chief point of interest to the photographer is that they neutralise acids, so

that a suitably balanced admixture of acid and alkali may be neither acid nor alkaline in reaction, but **neutral.**

We may regard water H_2O as an oxide of hydrogen. Several elements, *e.g.*, K, Na, etc., can replace one of the hydrogen atoms, and give a **Hydroxide,** *e.g.*, KHO, potassium hydroxide, caustic potash, NaHO sodium hydroxide, caustic soda, NH_3HO ammonium hydroxide, etc. These are strongly alkaline.

Hydrates are formed when a base combines with water. We have a familiar instance when "quick"-lime, CaO, calcium oxide, is "slacked" and combines with water, $CaOH_2O$, giving us slacked lime or calcium hydrate.

A Base is a substance which combines with an acid and forms a salt. Various oxides of metals act in this way, and are called **Basic Oxides.**

For example, silver oxide, Ag_2O, with nitric acid, HNO_3, forms silver nitrate, $AgNO_3$, and some water, H_2O, is also formed. A metal may also act as a base, and form a salt. Thus silver and iodine combine, directly forming silver iodide. The term base is wider than and includes the term alkali, for all bases are not alkaline. When part of the replaceable hydrogen in an acid is replaced by one base and and part by another base a **Double Salt** results. Thus in chrome alum we have a sulphate of chromium and sulphate of aluminium combined. Common or potash alum is similarly a double sulphate of potassium and aluminium.

A basic salt is somewhat similar to a double salt, in as much as it consists partly of a normal salt and partly of a hydroxide of the same metal as the normal salt.

An acidic oxide is one which combines with water to form an acid. It is also, and preferably called **anhydride.** Thus phosphoric pentoxide or phosphoric anhydride, P_2O_5, is formed when phosphorus is burnt in dry air or oxygen. This readily combines with water forming phosphoric acid. P_2O_5 and $H_2O = 2\,PHO_3$.

The freezing or melting points are the temperatures at which a body changes from liquid to solid or *vice versa*. The boiling point is the temperature at which it changes from a liquid to a gas. When a solid is dissolved in a liquid the solidifying temperature or freezing point is usually lower than that of the solvent by itself. But at sufficiently low temperatures most of the salts which are soluble in water form solid bodies in which water of constitution enters as it does in hydrated crystals, p 42. Common salt, for instance, mixed with ice does not solidify until the temperature is about 20°C (or 36 degrees below freezing on the F. scale), and then one molecule of the sodium chloride crystallises with 10 molecules of water. Such hydrated crystals that melt below the freezing point of water are called **cryo-hydrates.**

An alloy is a mixture of two or more metals. Thus brass is an alloy of copper and zinc, and bronze an alloy of copper and tin. Our silver coinage is alloyed with about $\frac{1}{18}$ its weight of copper.

An amalgam is an alloy of mercury with some other metal.

Halogen.—A term applied to each of the four elements, chlorine, bromine, iodine, fluorine, in consequence of their powers of forming salts (Gk Hals. salt) by direct combination with metals. These salts are called halides or haloid salts, *e.g.* silver bromide, etc.

A metal may be defined as an element which combines with oxygen and forms a base.

Names of Chemical Compounds.—When two elements combine the compound takes the termination **ide**, *e.g.*, silver bromide (bromine), iron oxide (oxygen), calcium carbide (carbon), etc.

If hydrogen combines with another element to form an acid it is prefixed by **hydro**, *e.g.*, hydrochloric acid, hydrofluoric acid. The salts from these acids take the simple termination **ide**, *e.g.*, calcium fluoride, sodium chloride, etc.

The first-discovered or best-known acid of any group of acids took the termination **ic**, *e.g.*, nitric, sulphuric, chloric acids, and the salts of these acids end in **ate**, *e.g.*, nitrate, sulphate, chlorate, etc.

Fig. 20 (p. 63). W. Astley.

Fountains Abbey.

Fig. 21 (p. 63). J. H. Saunders.

Fountains Abbey.

Before Treatment.

Fig. 22 (p. 63).

St. Thomas' Church, Leeds.

Fig. 23 (p. 63).

After Treatment.

S. Swinden.

The acid whose molecule contains one atom of oxygen less than the **ic** acid terminates in **ous**, *e.g.*, nitrous, sulphurous, chlorous acids, and their corresponding salts end in **ite**. Thus, nitrite, sulphite, chlorite. The acid whose molecule contains one less atom than the **ous** acid has the prefix **hypo**, *e.g.*, hyposulphurous, hypochlorous, etc., and the corresponding salts are hyposulphite, hypochlorite, etc. The acid which contains in the molecule one more atom of oxygen than the **ic** acid are prefixed by **per**, *e.g.*, persulphuric, perchloric, etc., and the corresponding salts are persulphates, perchlorates, etc.

We can best see the connection of these acids and their salts in tabular form :—

Acids.		Salts
HCl hydrochloric	$NaCl$ Sodium	chloride
$HClO$ hypochlorous	$NaCO$ „	hypochlorite
$HClO_2$ chlorous	$NaClO_2$ „	chlorite
$HClO_3$ chloric	$NaClO_3$ „	chlorate
$HClO_4$ perchloric	$NaClO_4$ „	perchlorate

Similarly we have H_2SO_3, H_2SO_4, the sulphurous and sulphuric acids, giving us the corresponding and familiar salts, Na_2SO_3, soda sulphite, Na_2SO_4 soda sulphate. But our familiar and valued friend hypo or hyposulphite is *not* Na_2SO_2 as the name might indicate. Its proper name, **thio-sulphate,** indicates its true composition which is $Na_2S_2O_3$, That is to say a sulphate in which one of the oxygen atoms has been replaced by an atom of *thion* or sulphur.

Again, if we start with sulphuric acid, *viz.*, H_2SO_4 and replace one of the two hydrogen atoms by an atom of sodium we have $HNaSO_4$ or sodium *bi-sulphate*, and similarly from sulphurous acid, H_2SO_3 we get $HNaSO_3$ or sodium *bi-sulphite.* If we take a double molecule of this $H_2Na_2S_2O_6$ and withdraw a molecule of water, H_2O, we have left $Na_2S_2O_5$ or sodium **meta-bi-sulphite.**

When two substances such as mercury and chlorine combine, we get chloride of mercury or mercury chloride. But it so happens in this case that we get these two elements combining in two different proportions, one of which contains just double as much chlorine as the other ; thus we

write the molecules HgCl and $HgCl_2$. The first may be called mercury **proto-** or **sub**-chloride and the other mercury **bi-** or **per**-chloride. But the more modern and better plan is to vary the ending of the metal mercury to mercur**ous** for the compound containing the greater proportion of mercury, *viz.*, the subchloride HgCl, and call it mercurous chloride. In the other case the metal termination is changed to **ic**, *viz.*, and $HgCl_2$, the perchloride called mercuric chloride. Similarly with other metals which form corresponding pairs of salts, we give the **ic** termination to that having the lesser proportion of metals, **ous** to that having the greater. Thus Cu_2O cuprous oxide, CuO cupric oxide, $FeSO_4$ ferrous sulphate, $FeCl_2$ ferrous chloride; $Fe_2(SO_4)_3$ ferric sulphate, Fe_2Cl_6 ferric chloride.

If one of the hydrogen atoms in water, HOH or H_2O, be replaced by a metal such as sodium, potassium, etc., we get a **Hydroxide**, NaHO, KHO, etc., which we are familiar with under the names of caustic soda and caustic potash. If in place of the metal we use a group of atoms having *twice as many atoms plus one* of hydrogen as there are carbon, we get a long series of bodies collectively known as **Alcohols**, *e.g.*, $CH_3.HO$ (methyl alcohol), wood spirit, C_2H_5HO (ethyl alcohol), spirits of wine, $C_3H_7.HO$ (propyl alcohol) etc.

If we start with a substance called benzene having the molecular formula C_6H_6, and replace one of the hydrogen atoms by the group OH hydroxyl (which we have seen combines with metals in the hydroxides and is so important in the alcohols), we get a substance C_6H_5OH called phenol or carbolic acid. If three of the H atoms in benzene be replaced by three hydroxyl groups, we get tri-hydroxyl-benzene, or pyrogallol, or more familiarly pyrogallic acid. Several of the developers such as amidol, metol, adurol, quinol (Hydrokinone) are derived from the benzene ring as it is called, and their relationship is suggested by their termination **ol**—an ending which suggests their possible relation to the alcoh**ol** series, as they may be regarded from a certain point of view. But pursuit of this subject would lead the beginner into undesirably controversial questions.

The Chemistry of the Dry Plate and Its Treatments.

By T.T.B.

THE dry plate received its name because not many years ago wet plates were universally employed in photographic work, and the photographer himself had to prepare his own just before they were exposed. Collodion was used as the "carrier" for the sensitive salts. Gelatine is used nowadays, and with it is mixed the sensitive compounds in the form of an *emulsion*.

A dry plate is a piece of glass coated with a thin liquid layer of a mixture of silver bromide and gelatine which is allowed to dry on it, and thus form a *film* of sensitive material. The dry plate is *sensitive* because light has the instantaneous effect of chemically altering the nature of silver bromide, so that it can be still further altered, visibly, by means of a *developer*.

Suppose, for example, that we place a plate in a dark slide, and in daylight half draw the drawer so that one-half the plate is exposed for a second to the light. On developing that plate in the dark-room, we should find that the half exposed to light would become black; whilst the unexposed half remained unaltered. This simple experiment shows definitely that the action of light so changes the nature of the sensitive film that this change can be *made visible*, or developed, by means of a suitable chemical solution, termed the developer. But whilst a second's exposure to a certain light would be necessary with one plate, a thousandth part of a second's exposure would produce the same effect with another plate; yet both are prepared with precisely the same materials, silver bromide and gelatine. We shall show presently how the sensitiveness or "speed" of a plate can be altered as desired, so that slow and rapid plates become possible.

The easiest way to understand how an emulsion, and eventually a dry plate, is made, is to make

both, and we shall, therefore, describe in simple language how an emulsion may be prepared without expensive apparatus, and how it may be used to prepare home-made plates. We can then more easily describe what happens when the plate is exposed, developed, etc.

The chemicals necessary are: silver nitrate, ¼ oz.; ammonium bromide, 1 oz.; potassium iodide, 1 drachm; gelatine (Nelson's No. 1), 1 oz.; ammonia, ·880, a few ounces; chrome alum, 1 oz.; distilled water, at least a quart. These materials should not cost more than eighteenpence, and the reader will no doubt already have some of them in the dark-room. The apparatus needed is not extensive, and comprises: a cheap chemical thermometer*; a stone-ware ginger-beer bottle; a glass rod for stirring; some clean glass measures; pair of scales; a square foot of fluffless canvas, such as art needlework dealers supply, with a mesh of about $\frac{1}{16}$ inch.

Everything can be done in full light up to the time of emulsifying, so we will first carefully weigh out and make up the two following solutions:—

A.	Distilled water	4 ozs.
	Ammonium bromide... ...	80 grs.
	Potassium iodide	4 grs.
	Gelatine	260 grs.
B.	Silver nitrate	¼ oz.
	Distilled water	2 ozs.

When dissolved, add just sufficient ammonia to re-dissolve the brown precipitate of silver oxide which at first forms; stir the solution the whole time you are adding the ammonia, and add no more the moment it becomes clear.

Now place the vessels containing these two solutions in hot water, and let them arrive at a temperature of 120°F., testing them from time to time with the thermometer, and changing the hot water as often as necessary.

Having thoroughly cleaned out the stone bottle, and finally rinsed it out with distilled water, pour A into it, and then take it and the B solution into the dark-room. In red light, add B to A about a drachm at a time, and between each addition cork the bottle, and shake it vigorously for at least

*About 1/-, of Griffin, Sardinia St., W.C.

thirty seconds; when B is all added, let the stone bottle stand in a jar of hot water, the water being about 150°F., and every ten minutes replenish this hot water with fresh at 150°F., allowing the emulsion to thus "digest" for an hour. Then remove the cork, and pour a drop of the emulsion on to a piece of plain glass, and bring this out into the light and examine it; you will find it to be a creamy looking fluid, similar in colour and appearance to the film of an unexposed plate.

What has been done then from a chemical point of view? In pouring the silver nitrate solution into the solution of bromide and iodide, silver bromide and silver iodide have been formed thus:—

$$AgNO_3 + (NH_4)Br = AgBr + (NH_4)No_3.$$

Silver nitrate added to amm. bromide *gives* silver bromide and amm. nitrate.

This simple exchange is known as double decomposition, and as each particle of silver bromide is formed it instantly becomes surrounded by a coating of gelatine, this intimate union causing the name *emulsion* to be given to the mixture. Although the gelatine does not combine chemically in any way with the silver bromide and silver iodide, the union of the two imparts new properties to the sensitive silver salts, *helping* the light subsequently to affect the film during exposure as we shall see later on.

Now, if immediately after emulsifying we had used the emulsion to coat our plates, two serious things would arise. In the first place, whilst silver bromide is formed on the one hand ammonium nitrate is formed on the other as a *by-product.* This salt is so deliquescent that its mere presence in the film would prevent the coated plates from ever drying. It must therefore be removed by a simple operation, *viz.*, "washing" of the emulsion. In the second place, the plates would be so slow as to be quite useless, the mere fact of keeping the emulsion liquid at a temperature of anything between 100° and 150° Fahr. for an hour or two materially increases the speed, hence the quicker we want our plates to be, the longer must we cook or digest the emulsion. Returning to the "dark-room" the emulsion when cooked in the ginger

beer bottle is poured out into a jam jar, and is kept in a cool place, and left (covered up so as to be light-tight), for about 24 hours. Next day, therefore, it will be found, when examined in ruby light, to have set to a stiff jelly. This jelly is removed from the jar with a bone knife or glass rod, and wrapped up in the square foot of fluffless canvas. The canvas is then turned round and wrung, so that the jelly is squeezed through the meshes like little worms; this operation must be done over a clean dish, into which the *shreds* may drop. The shreds, or little worms, are scooped up with a silver or bone spoon, and placed in a clean jar or pudding basin, which is filled to the brim, almost, with water. They are soaked in this for half an hour, and then, holding a piece of muslin or canvas over the jar to prevent the shreds falling out, the water is poured away and a fresh lot of water put in. The shreds are left to wash in this second water for another half-hour, and they are then scooped out and laid on an old handkerchief which is afterwards wrapped round them and gently squeezed until all moisture is removed. The shreds are finally put back in the ginger-beer bottle, and re-melted by standing the bottle in hot water; or the jam jar or a glass measure may be heated until the shreds re-melt, and the liquid then transferred to the stone bottle. Finally, two drachms of water in which one grain of chrome alum has been dissolved are added and shaken up with the emulsion, which is then strained or filtered through muslin, and the total bulk made up to 8 ounces; it is then ready for use.

Take care to keep the emulsion from the least touch or taint from impure vessels, dirty fingers, dishes, etc. Everything must be spotlessly clean if success be ensured.

For a few plates coated on an experimental scale, it is best to clean some waste negatives, by soaking them in boiling water to remove the films, and then rubbing each glass over with cotton wool wetted with :—

Sulphuric acid	1 ounce
Potassium dichromate	½ ounce
Water	4 ounces

This solution will thoroughly cleanse them, and

Fig. 24 (p 63). J. J. Rothwell.

The Young Builder.

Fig. 25 (p. 63). J. H. Saunders.

THROUGH THE VALLEY.

all they require afterwards is two rinses in tap water, and one in distilled water ; let them then dry in a rack without being wiped.

In order to coat plates, it is necessary to have some level surface handy in the dark-room, and a large sheet of glass about 18 inches square is desirable. Four two-inch screws should be put (half-way in) in the bench or table, and the glass stood upon these; a spirit level will at once tell whether the glass is horizontal, and if not the necessary screw or screws must be raised or lowered until the level shows that the sheet of glass when laid upon them *is* perfectly level.

Now for the coating. Hold a piece of glass on the finger tips of the left hand, and having the emulsion liquid and at a temperature of 90°F, hold the bottle with the right, and pour a pool of emulsion on the centre of the glass (about 1 drachm per quarter-plate area). Tilt the glass in all directions until completely covered, and then lay it upon the level slab of glass and allow the emulsion to set. This will take about two minutes in a cold room and four to five in a warm room.

When each plate is set it should be placed in a drying rack; the quantity of emulsion as above made would coat, roughly speaking, five dozen quarter-plates or their equivalent. We should recommend our reader to coat half a dozen on the first occasion, and to test these first. The time required for drying will be rather long if the room cannot be heated, but this drawback must be endured patiently: if the room be warmed with a stove before operations are commenced and the plates not put too close together in the rack, 24 hours should suffice to dry them.

If we require orthochromatic plates, all that is necessary is to mix with the emulsion one of certain aniline dyes, which have the power of making the emulsion sensitive to green, yellow and red rays of light; the ordinary emulsion is only sensitive to violet and blue, as was fully explained in No. 21 of *The Practical Photographer*. Make a solution up as follows :—

Alcohol	1 ounce.
Eosin yellow	5 grains.

This should be carefully filtered, and 1 drachm of it mixed with the emulsion if it be required orthochromatic. The reader is, however, strongly advised to leave this part of the work alone, as so little of even the red light of the dark-room is permissible with a colour sensitive emulsion.

We have next to consider what chemical change takes place during the exposure and after-treatment of the plate. Plates made at home in the way described are generally *very* slow, and we shall consider henceforward that the ordinary commercial article is being dealt with.

The sensitive silver bromide in the film, then, is so altered by light that its chemical properties are radically affected, and the exposed parts of the plate are no longer *ordinary bromide* of silver. Although modern theorists tell us that the change caused by light is purely physical in character, it is nevertheless a fact that the more readily the gelatine of the film absorbs bromine, the more rapid is the plate. We want by development to produce a black metallic image of almost pure silver in the film; to do this we must deprive the white silver bromide of its bromine.

Ag. Br.		=	Ag.	+	Br.
Silver Bromide; *i.e.*, unexposed film.	If developed gives—		Metallic Silver; *i.e.*, negative.		Bromine.

The process of decomposing the silver bromide, and producing black metallic silver is termed reduction, as we have seen in an earlier portion of this book, and reduction can only be carried out by the developer with silver bromide which has first been partially reduced by the action of light.

In order to deprive the light-affected Ag. Br. of its bromine, we have a variety of reducing solutions, the oldest of which is, perhaps, ferrous oxalate. Pyrogallic acid, metol, hydroquinone, etc., etc., are all available, but just as each one of us has individual characteristics, so each developing agent has different qualities, and yields a somewhat different class of negative. Now a developer works in a very simple manner, on the principle of giving nothing and taking everything; it extracts the bromine from the exposed portions of the film,

and adds it on to itself, roughly speaking*; more accurately, the bromine which is liberated is indirectly instrumental in causing oxidation of the developing agent, which, therefore, eventually becomes no longer "hungry" for more oxygen, *i.e.*, it becomes inert and exhausted.

Whenever a halogen is liberated, such as bromine, we are almost sure to have an acid formed, and as this would materially retard development, an alkali is necessary in the developer to destroy or neutralise it. In the case of ferrous oxalate, which stands alone in this respect, acid is not formed, and in reducing the silver bromide it merely becomes oxidised to ferr*ic* oxalate. But with pyrogallic acid and the modern developers, their oxidation is readily noticeable by their discoloration. Put a few grains of pyro in a test-tube, and sufficient water to dissolve it, and with a glass tube put to the bottom blow air through the liquid with the mouth; very soon the pyro becomes brown, owing to oxidation; a little caustic soda added to the solution makes oxidation much more rapid.

Make a little silver bromide in a test tube by mixing potassium bromide solution and silver nitrate solution, taking care to have an excess of bromide; add a few grains of pyro in the dark-room; nothing happens; now leave the tube in the light, near a window, and carefully add a little caustic soda solution; at once the white silver bromide darkens, and reduction takes place.

In order to prevent too-ready oxidation of the developer by the oxygen of the air dissolved in the water, or in the air space in the bottle, a *preservative* is added, and this is simply a substance which will take up oxygen more readily than the developing agent. Sodium sulphite, for example, takes it up thus:—

$$Na_2SO_3 + O = Na_2SO_4 \text{ (sod. sulphate).}$$

About five times as much sulphite is used generally as there is reducing agent, and from six to ten times as much sodium carbonate, or twice as much hydroxide, the latter being more powerfully

*According to theory, the bromine unites with hydrogen in part, which it extracts from the water, and the oxygen thus liberated *oxidises* the organic reducing agent.

alkaline. We could therefore now devise any developer on the following lines :—

Pyro, metol, hydroquinone, etc.	1 oz.
Sodium sulphite	5 ozs.
Sodium carbonate	6 to 10 ozs.
Water ... a suitable quantity, *viz.*,	100 to 300 ozs.

The alkali is usually made up in a separate solution, as it is the controlling lever of development; the more the alkali employed, the quicker will development take place.

When a plate is developed we have a black image consisting of metallic silver (and semi-reduced silver bromide) lying in the white film, the unexposed parts having remained unchanged except for *chemical fog*, which should be neglible with a clean-working plate. As the unchanged silver salts are still sensitive, it is necessary to remove them from the film, and for this purpose the plate is placed in the fixing bath, which is merely a solution which will dissolve them. If you make a little silver chloride in a test-tube, and add some ammonia to it, the white precipitate will dissolve; hence ammonia could be used to "fix" a chloride plate. Bromo-iodide plates, such as every-day dry plates, require something more powerful, and potassium cyanide was used originally; this is now quite replaced by the hypo with which we are all familiar, sodium thiosulphate, of the constitution $Na_2S_2O_3$. This converts the silver bromide and iodide into a compound salt, silver-sodium-thiosulphate, which readily dissolves, and consequently in a few minutes nothing is left on the glass but a pure gelatine film with an almost pure silver image embedded in it.

Place a little hypo solution in a test-tube and add to it a crystal of potassium metabisulphite, and when this is dissolved, test with a piece of blue litmus paper; the paper will turn red showing that the solution is acid. To a little hypo solution in another tube add a drop of acid (such as hydrochloric), and you will find that in giving an acid reaction, it also liberates sulphur as a white milky precipitate. Now we have seen that acids check development, and hence if we want to ensure development stopping as soon as the plate or paper

is put in the fixing bath, we merely make the latter acid. But in order to prevent the precipitation of sulphur, which might deteriorate the image by forming brown silver sulphide, we must use an acid salt such as sodium bisulphite or potassium metabisulphite, and not an acid pure and simple.

Having fixed the negative, the next thing to be done is to remove the hypo from the gelatine film, all the presence of the smallest trace will cause us imate fading by its eagerness to form metallic sutphides. Prolonged washing in frequent changes of water obviously effects this, but a quicker and surer method is to soak the plate for a minute or two in some solution which will convert the hypo into a harmless and extremely soluble compound. Certain chemicals rich in oxygen or halogen will effect this, such as hydrogen peroxide, iodosal; the hypo, once oxidised, is readily removed, and a short after-rinse in water quite cleanses the film.

We have finally to consider what are termed the after-processes, *viz.*, intensification and "reduction." Insufficient or over-exposure, insufficient or over-development, give us negatives which are too thin, too dense, or too light, and it is fortunate that such plates can be modified as desired. Intensifying a plate means rendering the image more dense, and this can only be done by increasing its opacity, *i.e.*, adding to it some opaque substance which will adhere chemically to it. For instance, we can "bleach" the negative in a solution of:—

Mercuric chloride	1 part.
Ammonium chloride	1 part.
Water	50 parts.

In this solution the black image soon becomes *white*, the mercuric chloride gives up half its chlorine to the silver, and silver mercur*ous* chloride is formed thus:—

$$HgCl_2 + Ag = HgCl.\ AgCl.$$

When bleached, the plate is immersed in ten per cent. ammonia solution, where it becomes again black and more intense. The ammonia converts the white double salt into a black ammonio-mercury compound, and also deposits metallic silver, so that the image is built up and added to. Other

darkening reagents such as hypo, sodium sulphite, etc., may be used, a black or brownish-black deposit resulting in each case.*

Another common method of intensification is to add to the image by precipitating upon it an insoluble *ferrocyanide.* If we mix equal parts of two per cent. solutions of uranium nitrate and potassium ferricyanide, we get a *solution* of uranium ferricyanide. If a negative is soaked in this, the silver image converts the soluble uranium salt into an *insoluble* substance (uranium ferrocyanide), which adheres to it, and thus intensifies it; the intensified image is brown like uranium ferrocyanide itself.

So-called "reduction*" is the reverse operation, and might be termed *thinning down*; it entails the dissolving away of the image to reduce its opacity. Consequently any substance which will dissolve silver may be used, provided it does not affect the gelatine of the film. Here we revert to oxidation. By using ammonium persulphate we convert the silver into a soluble compound and continue its action until the negative is sufficiently reduced.

A mixture of hypo and potassium ferricyanide works very vigorously, it first converts the silver into silver ferricyanide; and this dissolves in the hypo solution.

The two operations are simply summed up thus:—

Intensification:—Silver + intensifier = insoluble silver compound, therefore increased by the deposit.

Reduction:—Silver + reducer = soluble silver compound, therefore reduced, by the image partially dissolving.

Notes on Some of the Illustrations.

Fig. 7. "**Lily of the Valley.**"—April, 11 a.m.; in room, near small window; Barnet ortho plate and four-times screen; *f*/16; exp., 3 mins. We are particularly glad to reproduce this very charming little picture, because it shows what may be

* See No. 7 *Practical Photographer* "After-treatment of the negative."

Fig. 26 (p. 63). H. S. Prince.

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done with the simplest of materials; and for that reason alone, if for no other, it should prove of great service to our readers.—*Certificate, Floral Competition.*

Fig. 8. **Profile Study.**—July, 2 p.m.; *f*/8; exp., ·2 sec. We are very glad to have an opportunity of reproducing this print, as it encourages us to think that our print criticism hints are appreciated. The author submitted a print from the negative some months ago. On this we offered some suggestions. These were carried out, and we are free to admit that we ourselves are surprised to find the *immense* improvement they have effected. We regard this as one of the most original and tasteful studies we have seen for a long time.—*Print Criticism Award.*

Fig. 9. **"Through the Woods."**—August, 10 a.m.; Kodak plate and screen; *f*/8; exp., 2 secs. The author has not done justice to his print by putting it on a cold white mount. We omit this, and are sorry we are not able to remount it on a suitable grey tint.—*Print Criticism Award.*

Fig. 10. **"Ditton, Cambs."**—April, 3 p.m.; sun and clouds; Barnet ortho plate and screen; *f*/22; exp., 1½ sec. This picture will have a special welcome to those of our readers who have not forgotten their *alma mater* by the Cam. The whole scene is eminently characteristic of fenland scenery. The original print is just a trifle over-printed, but we hope to slightly soften this effect in our reproduction.—*Print Criticism Award.*

Fig. 11. **"Anxious Moments."**—August, dull light; *f*/11; exp., 2 sec.; Kodak plate. The title does not seem quite appropriate, but otherwise the print is of excellent quality, and the subject has the rare merit of being quite fresh and unconventional.—*Certificate, Figures Competition.*

Fig. 12. **"Crab-eating Raccoon."**—Dec., fair light; *f*/8; exp., 10 secs. An excellent example of good technical work combined with sound judgment as to suggestion of the general character of the animal by choice of a characteristic pose.—*Certificate, Animals Competition.*

Fig. 13. "**Contented.**"—Aug., 11 a.m.; Iso plate; *f*/8; exp., $\frac{1}{4}$ sec. Good technical work throughout, showing what may be done in the farmyard. Work of this kind has not received anything like the attention that it deserves. There is plenty of room for several specialists. The lighting was too much at the back of the camera for giving good relief.—*Certificate, Carbon Printing Competition.*

Fig. 14. **Pelargonium.**—June; *f*/22; ordinary plate; exp., 45 secs. Fig. 15. June; *f*/22; chromatic plate and screen; exp., 120 secs. A comparative glance will at once show the great gain in the rendering of the leaves by the use of the ortho plate. The blossoms show but very little difference. Seeing that green so largely enters into the average landscape, one can see how greatly the ortho plate has the advantage.—*Certificate, Orthochromatic Competition.*

Fig. 16. "**Swiss Shepherd Boy.**"—July, 3 p.m.; bright light; Kodak film; *f*/11; exp., $\frac{1}{50}$. The author has been a little misled by the brightness of the light, and not made quite enough allowance for the darkest parts of his subject. But still, taken as a whole, the result is very praiseworthy.—*Print Criticism Award.*

Fig. 17. "**What is it, Grandad?**"—June, 11 a.m.; dull light; *f*/6; exp., $\frac{1}{10}$ sec. The original is a very creditable enlargement from quite a small original. The print generally is a little too strong in light-and-shade contrasts. The dark doorway makes a good background for the old man's head; but the child's head is not very happily posed.

Fig. 18. "**The Nave, Ely Cathedral.**"—We have only one word to say, and that is excellent. The original print is exceptionally full of detail and delicacy, which we scarcely dare to hope to retain. The author is to be congratulated on his fine technical quality.—*Certificate, Champion Competition.*

Fig. 19. "**A Bit of the Conway.**"—June; *f*/16; exp., $\frac{1}{2}$ sec. A charming bit of landscape and figure work. It is just a little unfortunate that the figures happen to be so nearly all in a straight line

across the stream and at nearly equal intervals. This is one of those cases that seem to call for a suggestion of the glorious foliage tints of young summer.—*Certificate, Landscape Competition.*

Fig. 20. "**Fountains Abbey.**"—July, 11 a.m.; Kodak plate; *f*/45; exp., 7 mins.—*Print Criticism Award.*

Fig. 21. "**Fountains Abbey.**"—No details given. —*Print Criticism Award.*

It is interesting to put side by side two prints by two workers, taken at quite different times, and probably entirely unknown to each other. Both are excellent examples of careful work. Their differences are easily seen, very instructive, and will well repay careful comparison.

Figs. 22, 23. **St. Thomas's Church, Leeds.**—We here see an example of the gain by cautious use of local reduction and intensification. The author refers to p. 60, *The Practical Photographer*, No. 7, "After-treatment of the Negative."—*Certificate, After-treatment Competition.*

Fig. 24. "**The Young Builder.**"—October, noon; Barnet ortho; taken in a room; *f*/8; exp., 10 secs. The high-lights are perhaps just a little too strong, *i.e.*, dense in the negative; but, considering the difficulties of the subject, the result is highly praiseworthy.—*Print Criticism Award.*

Fig. 25. "**Through the Valley.**"—No details given. We have had this print before us for quite a long time waiting for an opportunity of reproducing it, and are at last glad to do so, as it is a charming bit of typical English scenery,—*Midg Competition Award.*

Fig. 26. "**The Close of the Day.**"—March, 5 p.m.; good light, after rain; chromatic plate, backed; *f*/8; exp., $\frac{1}{4}$ sec. A very charming picture, and also an admirable bit of composition as well. We regret that the print sent us was so small, or we should have given it a larger space, which it well deserves. —*Print Criticism Award.*

Light-Sensitive Substances (desirably kept in the dark.)
Ammonium Iodide.
Bitumen.
Ferric Ammonic Oxalate (ammonio-oxalate of iron).
Potassic Ferric Oxalate.
Silver Chloride.
,, Bromide.
,, Iodide.
Solution of Gold Chloride.
,, ,, Silver Nitrate.
,, ,, Potassium Chloroplatinite.

Volatile Liquids and Solids.
Ammonia Liquor (ammonium hydrate).
Ammonium Carbonate.
,, Sulphide ("stinko").
Benzine (vapour inflammable).
Bromine.
Camphor.
Carbon Disulphide (vapour inflammable).
Chloroform.
Ether (vapour inflammable).
Hydrochloric Acid.
*Hydrofluoric Acid.
* Must be stored in lead or gutta-percha bottles.
Potassium Cyanide.
,, Metabisulphite.
Sulphurous Acid.
Amyl Acetate (vapour inflammable).

Efflorescent Substances.
Copper Sulphate (slightly).
Ferrous Sulphate (iron protosulphate).
Potassic Ferric Oxalate.
Potassium Ferricyanide (red prussiate).
Soda Carbonate Crystals.
Sodium Sulphite.
Nickel Sulphate.
Cobalt Nitrate.
,, Chloride.

Deliquescent or Hygroscopic Solids (which should be stored in well-stoppered bottles).
Ammonium Sulphocyanide (thiocyanite).
,, Citrate.
,, Iodide.
,, Nitrate.
Calcium Hypochlorite (bleaching powder).
,, Chloride.
Cupric Bromide.
Chromic Anhydride (chromic acid).
Ferric Ammonic Citrate (ammonio citrate of iron).
Ferric Chloride (iron perchloride).
Auric Chloride (gold bichloride).
Potassium Chloroplatinite.
,, Citrate.
,, Cyanide.
,, Carbonate.
,, Hydrate (caustic potash).
,, Nitrate.
Sodium Hydrate (caustic soda).
,, Sulpantimoniate (Schlippe salt).
Uranium Nitrate.
Ammonium Persulphate.
Calcium Carbide.
Uranium Acetate.
Calcium Oxide (quicklime).

From **Messrs. Kodak** comes a leaflet describing an ingenious novelty in the world of hand cameras. This is called the "3B. Quick-Focus Camera." An indicator is put opposite the figure on a scale corresponding to the distance of the chief object to be photographed, a button is pressed, and without more ado the front of the camera instantly responds by flying out to the desired extension. For rapid snap-shot work so much time is saved, and records of events may thus be obtained which might otherwise be past and gone by the time one had racked out the camera in the usual tedious way. This camera takes roll-film negatives measuring $5\frac{1}{2}\times3\frac{1}{4}$, like the 3A F-P-K, which agrees sufficiently well with the wonderfully popular picture post-card.

From **Messrs. Houghtons, Ltd.** (88, High Holborn), we have received for inspection a piece of apparatus which breaks new ground. This is an invention for daylight loading of cut films. The flat cut film is loaded into an envelope of stiff black paper. This envelope consists of three parts: First, that holding the film; secondly, over this comes a piece sliding in grooves like the shutter of a dark slide; thirdly, the envelope enclosing the two other parts. The complete envelope is simply laid inside the holder, and the fingers seize the draw-out part of this adapter and a projecting portion of the envelope. The two slide together and lay bare the film inside the camera for exposure, when the two are returned together, and the exposed film, now safely covered up, may be removed and its place taken by another envelope and film. The Houghton Film Envelope Adapter is a thoroughly well-made piece of apparatus, somewhat after the style of an old-fashioned wet-plate single-plate holder with hinged back, which readily opens and closes with a safety spring, enabling film envelopes to be changed with great ease and rapidity in daylight.

We have not had an opportunity of actually trying this apparatus in the field, but everything seems to work so well and easily in the hand that it is not easy to imagine any difficulty arising. It will certainly not surprise us to learn ere long that this novelty is being very widely adopted and appreciated by cut-film devotees. It certainly is one of the most ingenious and simple things we have seen for a long time.

Messrs. Houghtons, Ltd. (High Holborn), have sent for our inspection a specimen of their three-guinea and their four-guinea Reflex Cameras. We have just given each of these two instruments a very careful examination, and come to the conclusion that they are both *remarkable value* for the money. The three-guinea instrument is provided with a full-sized finder on the reflex principle, two bushes for tripod work, an additional small brilliant finder, scale-focussing device, iris diaphragm and speed scale, carrying handle and catches for neck sling. The plates are carried in sheaths on the usual magazine camera system, but with certain detail improvements. Time exposures are, of course, provided for. The four-guinea apparatus has an "Ilex" rectilinear lens, and in this case the front of the camera is hinged and can be opened to alter the speed scale or stop. The front of the camera is also carried on a focussing rack and pinion and graduated for distance. The action of the apparatus is thoroughly practical. The shutter cannot be set, *i.e.*, lens uncovered, until the mirror is down, and thus the plate is protected. The shutter may then be set at "open" for focussing; a slight touch closes the shutter if required; a firmer pressure raises the lens, which in turn opens the lens for exposure. The plate is now changed by pressing a spring to one side. The mirror hood is hinged, so that we can easily get at the parts for cleaning.

We have not actually made any exposures with either of these cameras, but as far as our judgment goes we cannot see how anything can possibly go wrong, if only the plate sheaths are properly loaded into the camera. So far as we know these are the only *reflex and magazine* hand cameras on the market.

From **Messrs. H. Edmund & Co.** (Ezra Street, E.) we have received a sample of Sanzol. This is a fine powder of a very beautiful golden colour. Following instructions we dissolved 2 grains of this powder in 1 oz. of water, adding 14 drops of nitric acid. This yielded an orange solution. A negative too strong in contrasts was put in this and rocked for about 10 or 12 minutes, when it was gradually reduced to the desired degree of softness. Action was stopped by a bath of dilute ammonia (14 drops per ounce) and then washed. Sanzol acts much in the same way as ammonium persulphate, that is to say it converts a black and white or harsh, contrasty printing negative into one giving soft contrasts without materially affecting the finer details of the shadows. It will therefore be particularly valuable in cases of negatives yielding too much contrast of light and shade in the print. Sanzol is certainly a very valuable addition to our reducing agents.

From **Messrs. Wellington & Ward** we have received a carefully made and neatly-sent-out Light Filter, of pale yellow colour, especially adapted for use with their orthochromatic plates. The filter involves an increase of five time unscreened exposure. These filters are in metal rims with spring clasps to fit on to the hood of a lens. Sizes: 1 to $1\frac{3}{8}$ inches, 10/6; $1\frac{3}{8}$ to $1\frac{5}{8}$, 12/6. We have not yet had an opportunity of trying this filter, but we have every confidence that it will be fully up to the high standard of all the other excellent productions of this firm. We hope to record some experiments later on.

From **The Rotary Photographic Co.** (12, New Union Street, E.C.) we have received a sample packet of "*Silvo*," This is a kind of Bromide paper or card, *but* with the important difference that when finished the picture appears to be on a beautiful silver-like surface of aluminium in place of paper. These "Silvo" cards and papers are manipulated just like ordinary Rotox cards, so that the Bromide paper worker has nothing new to learn. The effect is quite different from any other photographic production, and is very striking. We could well imagine that with a suitably-selected subject the silver-like background or supporting surface would produce quite a sensation among the uninitiated. And be it noted that one can buy twelve of these silver-like Silvo cards for a modest shilling. Silvo is manufactured in Rotograph and Rotox and in various sizes at surprisingly cheap rates.

From the **Synoloids Company** we have duly received some paper and Synoloids. Our first trial was quite successful, and we shall give notes on further experiments shortly.

From **Messrs. O. Sichel & Co.** we have recived a sample tube of Platinochrome Paper, but at the moment of going to press our experiments were incomplete. We hope to give further notice to this very interesting printing process at an early date.

From **Messrs. Houghtons, Ltd.**, we have received a specimen of their Gem Self-lighting Gas Burner. This is a neat little fitting that can be screwed to any ordinary gas bracket at a moment's notice. The gas is first lighted with a match in the ordinary way, then by a touch of one or other of two little chains we have full light or darkness at will. We have had a somewhat similar contrivance in our own dark-room for sometime past, and found it of the greatest possible convenience, therefore we can heartily advise the investment of 2/6 in a Gem of this kind.

The Bolton Amateur Photographic Society. Open Exhibition, April 18-21. Hon. Secs., Messrs. Midgley and Kellam, 9, Ducie Avenue, Bolton.

G.E.R. Mechanics' Institution, Stratford, E. Exhibition, Open Classes, March 13-14. Hon. Sec., A. Woolford, 16, Grove Green Road, Leytonstone.

Prints for Criticism, etc.

Will competitors and others please kindly note our rule to the effect that when prints are to be returned stamp must be sent **WITH THE PRINTS** — *not afterwards?*

Will contributors to our various competitions kindly refrain from sending under one cover prints for different competitions? This not only gives us considerable trouble, but involves the risk of the various pictures not being properly entered for the competition for which they are intended. It is far better for all concerned to send each lot of prints in separate parcels.

Will competitors also please bear in mind that the prints received during the month cannot be judged till the last day of the month, and that as we go to press about the 20th of the month it is not possible to criticise prints in our issue dated the month next to that when the prints were sent in?

A. C. (Leeds).—One of your prints has a much too elaborate pattern of mount. This pattern takes up so much of our attention that we scarcely notice the picture. Observe that the general direction of the hat agrees with the direction of the top of the hedge in the distance. It would have been

better had the hat been tilted the other way, but we see that your subject was trying to shade her eyes. The colour of this print is a little too red. You might considerably improve this by very slightly toning down the sky portion, using a colour not quite so pronounced, and putting on to a mount of dark, neutral green. The river picture is a very pleasing arrangement of subject, and you have chosen your point of view with good judgment. The sky part is a little too paper-like, and also the river bank at the bend of the stream. It will be easy to tone down the sky, and slightly reduce the bank at this corner. This mount is very much better than the one just mentioned. Your third picture arrived in two portions, owing to the mount having broken away from the print. All things considered, we regard the third as the most interesting subject. Technically it is good also, but the colour is *much* too red. Try this again in warm sepia platinotype, aiming to get a colour only slightly suggestive of brown.

J. R. R. (Burnley).—The print you have sent us has some very excellent points, and it is nearly being quite good, and yet just misses it by a trifle. The hazy distance is a little overdone for pictorial purposes, though it may be true enough to nature. One must remember that all nature's effects are not always pleasing, and the artist has to select from and sometimes modify the dishes that nature puts before him, to suit his own pictorial palate. The composition is excellent, but the more distant parts are scarcely real enough. Bear in mind that the photographic plate usually exaggerates atmospheric fog.

M. B. (Wisbech).—Both your sheep studies are pleasing arrangements; print 2 being the better. In print 3 the sheep fall more or less into three groups at about equal distance. This is, of course, a thing to avoid. We like the shape of your pictures, but do not like the white mounts, or the blank skies. These two defects tend to accentuate the faults of each other. It would be a very easy matter for you to tone down the skies and use plain gray mounts. The picture of roses arrived in a somewhat damaged condition, as you will see. This is rather a pity, as the study has some very good points from the technical side. The arrangement is a little too artificial; that is to say, too suggestive of having been arranged, and is not natural enough. In flower work, we should aim to get groupings so disposed that they look as though they might occur in nature, but it is difficult to imagine such an arrangement as you have occurring in that way.

A. E. B. (Bristol).—This print is scarcely up to your best form. The mounting and general arrangement is fairly good, but the composition is not quite satisfactory. The edge of the building which comes so near the central line is too pronounced, and tends to cut your picture into two portions. The whole print is just a little too weak, and not suffiiciently suggestive of solid masonry. There is a kind of general haze or fog all over it, which points in the direction of something faulty in your manipulation. It is possible that the paper itself has become in some way fogged.

S. W. L. (Herne Hill).—The scene depicted is one of interest, but you have not been quite successful in the point of view. The railing in the nearest portion of the picture cuts off a rather ugly triangle with the two sides of the print. The print itself is also a little too black and white. You evidently have under-estimated the exposure and probably also carried development a little too far. Always bear in mind that the leaves of trees cut off some of the actinic rays, which are, of course, essential to us in photography. This quality of foliage is very apt to deceive us, as we are tempted to judge by the brightness of the green colour which they present.

O. W. F. T. (Coleville).—We are much interested in seeing the two prints from the same negative. Of course, we should like to have parts of one print combined with parts of the other. Speaking generally, print 1 gives us the most agreeable impression of the scene which we know quite well, but the strong light coming through the window, and nearly obliterating the edge of the wall at the turn of the stair, is anything but satisfactory. The window portion in print 2 is better, but even here the strong light on the wall is a little too much for pictorial purposes. We would suggest that you make from your negative a transparency or positive by contact, giving a generous exposure, and developing this positive with metol, *not* quinol. Then, from this somewhat thin positive, rich in detail, you can make a new negative by contact, again using only metol, so as to get a shorter scale of gradation. The kind of

quality to aim at is that which you have in print 1, showing the lowermost half-dozen steps of the staircase. This part of your print is exceptionally good, and of course this is the standard to aim at. We shall be interested to know the result of your experiments.

K. F. B. (Warrington).—The general idea and arrangement of the picture is satisfactory, but why did you let your sitter turn round to stare at the camera, and so "give the show away," when he would more naturally have been looking at his picture-book? Never have your sitter staring at the camera, whenever you can arrange him in any other pose. The weak part of the picture is in the high-lights, which are a little hard and lacking in gradation. The exposure was probably about right, but it would seem that the lighting was too much all on one side. What you wanted was a good-sized clothes-horse, covered by a white sheet, and used as a reflector behind the sitter's chair, but of course out of the picture. Possibly you have carried development a little too far. The strong light in the whites of the eyes should be very carefully reduced by means of the scraper. See our special number on Retouching, No. 14.

J. P. (Halifax).—(1) This is a tastefully-arranged little picture. The chief fault is that the darker portions are a little too solid. You have evidently carried the development of the paper a little too far, and not made due allowance that the wet print would look a full shade darker when dry. (2) Technically this also is very creditable work, but here again your print is just a little overdone. This is not quite such a graceful arrangement as print 1, although it is very creditable work. You might advantageously remove ⅜-in. from the left-hand side, and about a ½-in. from the right-hand side. This would give you better proportions. (3) We are glad to see that your sitter is so very sensibly occupied. We think he could not have a better book in his hands! His hat, of course, is very much too white. This tells us that the density contrasts of the picture are overdone. You have probably carried development too far, and perhaps also got a little yellow (Pyro.) stain in your negative. The right-hand corner indicates fogging. The position of your sitter, though looking comfortable enough, is not very elegant, especially as regards the arrangement of his legs.

H. H. T. (Glasgow).—"Lilies." The arrangement is just a little too stiff, one upright and one on each side at nearly equal angles, is too formal. The lilies also are all such a similar colour, that the little patches of white are rather fidgeting. As a rule it is better to try and get small flowers very nearly life-size. We think you have probably carried development a little too far, and hence got the high-lights too dense and white-printing. A good flower negative is nearly always characterized by great delicacy and softness. "Tulips." This is a very much more elegant arrangement. Our chief fault to find here is not with the flowers, but with the use of such an ornamental vase in the first place, which takes too much of our attention from the flowers, and secondly such a strongly-marked sharp line between the light background and dark table. This you must get rid of next time by avoiding such strong contrasts of table and background.

E. M. C. (Norwich).—We do not care for this very flimsy style of mount. The mounting paper should first be pasted down to a stout card which has previously been well damped by means of a sponge having been passed slowly over it. (1) The contrasts of light and shade here are very much too strong. Instead of 1/25th of a second, had you given a full second you would probably have been very much nearer the mark. A considerable portion of your picture is really blank white paper and in a well-balanced picture one scarcely has any absolutely blank paper. (2) Here again the exposure is considerably underdone. We feel that in both cases the disease is too severe for us to suggest any remedy likely to be satisfactory. When in doubt it is always wiser to err on the side of over rather than under-exposure.

R. P H. (Westcliff-on-Sea).—You are evidently a careful worker, and we are glad to see this. Print No. 3 shows one or two scratch-like marks which call for your careful attention. See if there is anything in the dark slide of your camera to account for these. This print has a blank paper sky, which, of course, is contrary to nature. This difficulty you can easily remedy by a little toning down of this part. (2) The general arrangement of subject here is decidedly better, but still your sky remains blank and devoid of all

suggestion of atmosphere. The print itself is just a little too heavy and sombre. You probably have carried development a trifle too far and not made due allowance for the difference between a wet and dry print. (1) Here again your print is just a little lacking in the luminosity which we associate with the break of day. It would be a valuable lesson for you to tear a print in half, thoroughly wet one portion, and then put it side by side with the other dry portion, noticing the difference that the water makes in light and shade values, and bear this in mind for all paper pictures (photographs and paintings.)

F. A. T. (Sheffield).—(1) We like the general arrangement of this picture, but we certainly do not like the colour for this subject. It seems too assertive, too pronounced. Again, the picture is on rather too small a scale for the suggestion of largeness that one ought to have in a case of this kind. We think it would be quite worth your while to enlarge this to just about twice its length, and use some other colour not quite so conspicuous. (2) The children here seem to us far too conscious of the presence of the camera man; in fact, they do not look sufficiently childlike in their pose and expression. The whole picture also is a little flat and monotonous. (3) Here you have an agreeable picture, and very pleasing in proportion and size, but a good deal of the ground part, (grass, etc.) is too ethereal looking, not sufficiently real. What one wants is a general lowering of the tones of the ground part without altering the rest of the picture. This might be done by very carefully masking the glass side of the negative over those parts that you do not want to make any darker, while the parts printing too light are left clear.

A. G. W. (Palmer's Green).—We are glad to know that our previous hints have been helpful to you. Your print this time has some very good points, but at the same time is weak on the technical side. The general arrangement is excellent, but the nearer parts of the picture are too unreal and unsubstantial looking. Without actually seeing the negative, it is difficult to say what is at fault, but it seems to us that the trouble lies in the granularity of the paper negative. We think you would be more likely to succeed by making your enlargement direct on to the paper in the usual way in a case of this kind.

R. L. (Castlemartyr).—Two of your three prints were both very hot in the running this month, but in each case a little thing turned the scale. Print 1. The general arrangement of the clouds is too much like a row of more or less similar lumps of light and shade. The sky looks too much broken up into patches. This is a case where probably a black and white result would be really more effective, and would suit the sentiment of the scene better. Can you soften the sky line of the distant land just a little? (2) In this case the sky part requires a little darkening at the top, very much after the general arrangement of the light and shade in the nearer portion of the water. At present the upper part of the sky looks too bright for the scheme of light of the figure and stones, etc. With a little careful working this picture might be considerably improved. (3) The two cows to our extreme left are unfortunate intruders in this scene. Now here is a case where a very moderate degree of skill combined with a generous measure of patience would enable you to entirely obliterate these two cows from the scene and simply melt in these spaces to agree with the surrounding portion. If you will cover up with your finger these two cows you will see how much the harmony of the composition is improved. We hope you will follow our advice and let us see the new result along with this print once again. (Consult *Practical Photographer*, No. 14).

C. P. (Alexandra Park).—(1) This is an excellent group, and apparently quite unconscious of the camera, but its weak point is the patchiness of light and shade. A little retouching will make a good deal of improvement. First of all remove the patch of light behind the straw hat of the second woman, then soften down the sky, which is at present too bright (though small); then tone down the two aprons and soften the patch of light on the ground behind these two white aprons. (2) This is a capital group, and again apparently quite unconscious of the camera, but your sky is not sufficiently sky-like. You do not require clouds here, but merely a suggestion of atmosphere, which you can get by toning down the sky space generally, as fully explained in our number on pictorial printing (No. 24). The jacket of the man with his back to us is just a little too light, and also requires a little careful rubbing down to about the same value as the jacket of the man to our extreme right.

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A9	48	smoke gray	**A09**	32
A10	48	fern green	**A010**	32
A11	48	coffee	**A011**	32
A12	48	wine red	**A012**	32
A13	48	black	**A013**	32
A14	48	olive green	**A014**	32
A15	48	iron gray	**A015**	32
A16	48	russet	**A016**	32
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B3	36	gray bark	**B03**	24
B4	36	playfield cream	**B04**	24
B5	36	rough white	**B05**	24
B6	36	dove	**B06**	24
B7	36	deep sea blue	**B07**	24
B8	36	autumn brown	**B08**	24
B9	36	smoke gray	**B09**	24
B10	36	fern green	**B010**	24
B11	36	coffee	**B011**	24
B12	36	wine red	**B012**	24
B13	36	black	**B013**	24
B14	36	olive green	**B014**	24
B15	36	iron gray	**B015**	24
B16	36	russet	**B016**	24
B17	36	slate	**B017**	24
B18	36	drab	**B018**	24
B19	36	brown	**B019**	24

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C4	24	playfield cream	**C04**	16
C5	24	rough white	**C05**	16
C6	24	dove	**C06**	16
C7	24	deep sea blue	**C07**	16
C8	24	autumn brown	**C08**	16
C9	24	smoke gray	**C09**	16

To take sizes up to ¼-plate.

Ordinary Thickness. No.	Contains sheets 12×10 in.		Extra Thick Series. No.	Contains sheets 12×10 in.
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C11	24	coffee	**C011**	16
C12	24	wine red	**C012**	16
C13	24	black	**C013**	16
C14	24	olive green	**C014**	16
C15	24	iron gray	**C015**	16
C16	24	russet	**C016**	16
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